

Revision of the snailfish genus *Allocareproctus* Pitruk & Fedorov (Teleostei: Liparidae), with descriptions of four new species from the Aleutian Islands

JAMES WILDER ORR¹ & MORGAN SCOTT BUSBY²

National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Resource Assessment and Conservation Engineering Division, 7600 Sand Point Way NE, Building 4, Seattle, WA 98115, U.S.A; E-mail: ¹James.Orr@noaa.gov; ²Morgan.Busby@noaa.gov

Table of contents

| | |
|--|----|
| Abstract | 1 |
| Introduction | 2 |
| Method and materials | 3 |
| Systematic accounts | 4 |
| <i>Allocareproctus</i> Pitruk & Fedorov 1993 | 4 |
| Key to species of <i>Allocareproctus</i> | 13 |
| <i>Allocareproctus jordani</i> (Burke 1930) | 14 |
| <i>Allocareproctus tanix</i> new species | 20 |
| <i>Allocareproctus kallaion</i> new species | 23 |
| <i>Allocareproctus unangas</i> new species | 27 |
| <i>Allocareproctus ungak</i> new species | 30 |
| Statistical analyses | 33 |
| Acknowledgments | 36 |
| References | 36 |

Abstract

Liparid fishes of the genus *Allocareproctus* Pitruk & Fedorov were collected throughout the Aleutian Islands during surveys conducted by the Alaska Fisheries Science Center, U.S. National Marine Fisheries Service, and represent the first documented records of this genus in North America. Based on this material, we revised the genus and recognized four new species described herein. *Allocareproctus* is distinguished from all other liparid genera by the following characters: anterior 4–8 dorsal-fin rays with tips exserted from the fin membrane, papillae associated with some pores of the cephalic lateralis system, and symplectic extending to the medial aspects of the

quadrate and metapterygoid. *Allocareproctus jordani* (Burke), the type species of the genus, is uniformly pink-red in coloration, with a dark peritoneum, simple teeth, a pigmented nasal papilla, and a single lobe on the orobuccal valve. It ranges from Sagami Bay, the type locality, north through the Kuril Islands, and east to Umnak Island of the Aleutian Islands, at depths of 75 to 495 m. *Allocareproctus ungas* n. sp. is most similar to *A. jordani*, differing in having trilobed teeth, an unpigmented nasal papilla, and higher counts of median-fin rays and vertebrae. It is found only between Seguam Pass and Samalga Pass in the east-central Aleutian Islands at depths of 318 to 461 m. *Allocareproctus kallaion* n. sp. is also known only from Seguam Pass and Samalga Pass at depths of 278 to 450 m and is distinguished from all other species of *Allocareproctus* by its blotchy red body color in life and dusky head coloration in life and in preservation, high gill raker count, high precaudal vertebrae count, and comb-like orobuccal valve. *Allocareproctus tanix* n. sp. is most similar to *A. ungas* n. sp. and is distinguished by its orange-peach coloration, pale peritoneum, absence of an interorbital papilla, and greater body depth. It is found only in the central Aleutians at depths of 104 to 650 m. *Allocareproctus ungas* n. sp. is also found only in the central Aleutians at similar depths of 210 to 465 m and is distinguished by its trilobed teeth, absence of a nasal papilla, and dark peritoneum. Based on our examination of holotypes, *Careproctus pycnosoma* Gilbert & Burke and *C. curilanus* Gilbert & Burke are valid species and not synonymous with *A. jordani*.

Key words: Liparidae, snailfishes, North Pacific Ocean, Aleutian Islands, taxonomy, morphology, new species, *Allocareproctus jordani*.

Introduction

Commonly known as snailfishes, the Liparidae is a diverse family of fishes characterized by pelvic fins that are highly modified into a sucking disk (or absent) and a body that is naked and relatively elongate. Liparids thrive in a variety of temperate to subarctic marine habitats, including the shallow intertidal and oceanic trenches at depths of over 7000 m. Chernova *et al.* (2004) recently listed 29 valid genera of liparids worldwide. About 22 genera, encompassing approximately 155 species, are presently recognized from the North Pacific, including a more recently described monotypic genus, *Lopholiparis* (Orr 2004).

The genus *Allocareproctus* Pitruk & Fedorov was originally erected for the single species *Careproctus jordani* Burke (a replacement name for *C. gilberti* Jordan & Thompson). Until the collection of 15 additional specimens from the Kuril Islands (Pitruk & Fedorov 1993), *Careproctus jordani* had been known only from the holotype collected in or before 1911 from Sagami Bay, Japan. This specimen was subsequently redescribed by Burke (1930) and Kido (1988). Based on their new material, Pitruk & Fedorov (1993) concluded that the distinctive morphology of the species warranted generic rank and established the genus *Allocareproctus*. According to Pitruk & Fedorov (1993), *Allocareproctus* is distinguished from other liparid genera by the presence of small whisker-like papillae on the pores of the upper portion of the head, the extension of the symplectic to the medial aspects of the quadrate and the metapterygoid, and the protrusion of the ends of the anterior rays of the dorsal fin beyond the connective membrane.

Based on nearly 200 additional specimens collected in the Aleutian Islands by resource assessment surveys conducted by the Alaska Fisheries Science Center, U.S. National Marine Fisheries Service (NMFS), we describe here four new species of *Allocareproctus*. In doing so, we affirm the validity of the genus *Allocareproctus*, while providing a revised diagnosis and description of the genus. A key to the species is provided with a diagnosis and description of each species.

Method and materials

Counts, measurements, and descriptive terminology follow Stein *et al.* (2001), with the exception of pectoral-fin ray counts. The rays of the dorsal lobe of the pectoral fin are counted from the dorsalmost (first) ray to the shortest ray in the shallow notch above the lower lobe. The rays of the lower lobe are counted from the succeeding ray to the ventralmost ray at the pectoral symphysis. Counts of median-fin rays and vertebrae were taken from radiographs. The right gill membrane and abdomen were slit to examine branchial and visceral cavities. Counts of gill rakers were taken from the first gill arch on the right side. We refer to the small projections of tissue associated with pores of the cephalic lateralis system as papillae (= “whiskerlike tuberosities” of Pitruk & Fedorov 1993; = “flaps” of Kido 1985, 1988). Lengths are presented as standard length (SL) and percents as percent SL, unless otherwise indicated as percent head length (HL), pelvic disk length (DL), or caudal length (CL). Measurements and counts are presented in the species accounts as the range for all material examined followed by the value for the holotype in parentheses when intraspecific variation is indicated. All material examined, with the exception of the holotype of *A. jordani*, was obtained from benthic otter trawls. Where noted, some material was collected in a small “benthic bag” attached near the footrope of the otter trawl as described by Orr (2004). Institutional abbreviations follow Leviton *et al.* (1985).

Individuals were identified to species for statistical analyses by using the non-meristic or non-morphometric diagnostic characters provided in the systematic accounts below. Univariate analyses were conducted using Statgraphics Plus 4.1 (Manugistics, Rockville, MD) and multivariate analyses using Splus 6.2 (Mathsoft, Inc., Seattle, WA). Differences were considered significant at $P < 0.01$.

For all species other than *A. tanix* n. sp., log₁₀-transformed morphometric ratios (with SL as denominator) and raw meristic characters were tested to meet the assumptions of normality and homogeneity of variance required for ANOVA and ANCOVA. The following morphometric characters met these assumptions and were subjected to ANCOVA, using SL as covariate: head length; body depths at anal-fin origin, between dorsal-fin origin and anal-fin origin, at pectoral-fin base, and at pelvic disk; snout length; orbit length; interorbital width; suborbital depths to oral cleft and mandible; upper pectoral-fin length; predorsal length; preanal length; snout to anus length; pelvic disk

length and width; pelvic disk to anus length; and lengths of attachments of dorsal fin and anal fin membranes to caudal fin. The ANCOVA model included species as a factor, SL as a covariate, and a species/SL interaction. A residual analysis was done for each model to determine the appropriateness of the model. Whenever the interaction was not significant (at the 5% level), a reduced model was used, dropping the interaction and forcing the slopes to be the same. This removed the effect of SL and allowed testing for significant differences between species. Counts of the following meristic characters also met assumptions and were subjected to ANOVA: dorsal-, anal-, and pectoral-fin rays, and gill rakers. Differences among species were tested by Fisher's least significant difference procedure. Because only four specimens of *A. tanix* are known, differences among individuals of this and other species were considered significant on the basis of non-overlapping 99% confidence intervals. On a dataset of specimens with all characters, standard principal components analysis (PCA) was conducted on the correlation matrix of raw meristic characters. Differences between species were illustrated by plotting scores of PC1 against PC2.

Systematic accounts

Allocareproctus Pitruk & Fedorov 1993

Figures 1–13; Tables 1–4

Type species: *Careproctus jordani* Burke, by original designation of Pitruk & Fedorov (1993).

Comparative material examined

Careproctus attenuatus, USNM 74386, ca. 32 mm, Aleutian Islands, S of Agattu I., 52.24°N, 174.22°E, 882 m depth, 7 June 1906, R/V *Albatross*, sta. 4781 (poor condition); *Careproctus opisthotremus*, USNM 74385, 39.8 mm, Aleutian Islands, S of Agattu I., 52.02°N, 174.65°E, 1913 m depth, 7 June 1906, R/V *Albatross*, sta. 4780; *Careproctus ectenes*, USNM 48618, ca. 50 mm, and USNM 53031, ca. 50 mm, Aleutian Islands, N of Unalaska I., 54.03°N, 166.81°W, 640 m depth, 21 August 1890, R/V *Albatross*, sta. 3331 (poor condition); *Careproctus pycnosoma*, USNM 73340, 39 mm, Kuril Islands, off Simushir I., 46.7°N 151.75°E, 419 m depth, 24 June 1906, R/V *Albatross*, sta. 4803; *Careproctus curilanus*, USNM 73341, 64 mm, Kuril Islands, off Simushir I., 46.7°N, 151.75°E, 419 m depth, 24 June 1906, R/V *Albatross*, sta. 4803; *Careproctus candidus*, USNM 74384, holotype, 60.7 mm, and USNM 74527, paratypes, 2(57–63 mm), 52.93°N, 173.43°E, 247 m depth, R/V *Albatross*, sta. 4784, off Attu I., 11 June 1906; *Lopholiparis flerxi*, UW 47868, 32.5 mm, holotype, Aleutian Islands, off Ulak Island, 51.4593°N, 178.4612°W, 285 m depth, F/V *Vesteraalen*, cruise 2000-01, haul 120, 20 June 2000, W.C. Flerx; *Prognatholiparis ptychomandibularis*, UW 42431, 88 mm, holotype, Aleutian

Diagnosis

Small papillae present on some pores of cephalic lateralis system (Figs. 3–4); nasal pores 2, maxillary pores 6, preoperculomandibular pores 7, suprabranchial pores 2 (pore pattern 2-6-7-2; Fig. 4A); symplectic extending to medial aspect of quadrate and metapterygoid (Fig. 5); tips of anterior 4–8 dorsal-fin rays extending beyond dorsal-fin membrane (Fig. 3); pelvic disk large, 30–45% HL; gill slit small, entirely above pectoral fin; nare single; pseudobranch absent; pectoral radials 4 (3+1), robust, notched, interradiar fenestrae three (Fig. 6); pupil of eye round.

Description

Body moderately robust, cylindrical in cross section, nearly uniform in depth from anterior to posterior, tapering slightly posteriorly. Head moderately large, dorsal profile gradually sloping from nape to snout. Snout rounded, slightly projecting beyond upper jaw. Mouth small, maxilla extending to midorbit, oral cleft to anterior rim of orbit. Lower jaw terminal, premaxillary tooth plates matching mandibular tooth plates. Premaxillary teeth simple to trilobed in 8–10 oblique rows, increasing from 3 teeth anteriomedially to 16 teeth posterolaterally. Mandibular teeth simple to trilobed in 9–12 oblique rows, increasing from 4–6 teeth per inner row to 34 teeth in outer row. Diastema absent at symphysis of upper and lower jaws. Orbit large, about 20–32% HL, dorsal margin excluded from dorsal contour of head, suborbital depth to oral cleft 20–60% orbit length; pupil round. Interorbital space wide, slightly convex. Snout slightly longer than orbit, 25–36% HL. Branchiostegal rays 6. Nare single, in well-developed tube at level with upper part of orbit; nostril tube length 2.0–11.0% HL.

Cephalic lateralis pores of moderate size: nasal pores 2, maxillary pores 6, preoperculomandibular pores 7, suprabranchial pores 2 (pore pattern 2-6-7-2; Fig. 4); papillae on rim of some pores; chin pores paired in separate pits. Interorbital (= coronal of Pitruk & Fedorov 1993) pore absent; interorbital papilla present or absent. Cephalic free neuromasts relatively large and profuse or nearly indiscernible. Free neuromasts (Andriashev & Stein 1998) about 15, small and difficult to discern, originating from above gill slit and extending to a level at mid-body above anal-fin origin. Gill opening small, 15–30% HL, upper margin at level of dorsal rim of orbit to just above pectoral fin or extending to pectoral-fin ray 1–3. Opercular flap rounded or angular. Pseudobranch absent. Branchiostegal rays 6. Symplectic expanded posterodorsally, overlapping ventral part of metapterygoid and posteroventral portion of quadrate blade (Fig. 5).

Dorsal-fin rays 39–45 (Table 1), tips of anterior 4–8 rays projecting from fin membrane, anterior 5 rays uniserial and unsegmented, more posterior rays biserial and segmented; all rays simple. Anteriormost dorsal-fin ray supported by two pterygiophores;

the anteriormost inserted between neural spines 2 and 3. Anal-fin rays 33–39 (Table 1), anterior ray uniserial and unsegmented, more posterior rays biserial and segmented; all rays simple. One to three anal-fin pterygiophores and associated rays anterior to first haemal spine; posteriormost 2 neural and haemal spines without associated dorsal- and anal-fin rays. Anal-fin origin below vertebrae 10–13 (caudal vertebrae 1–3).

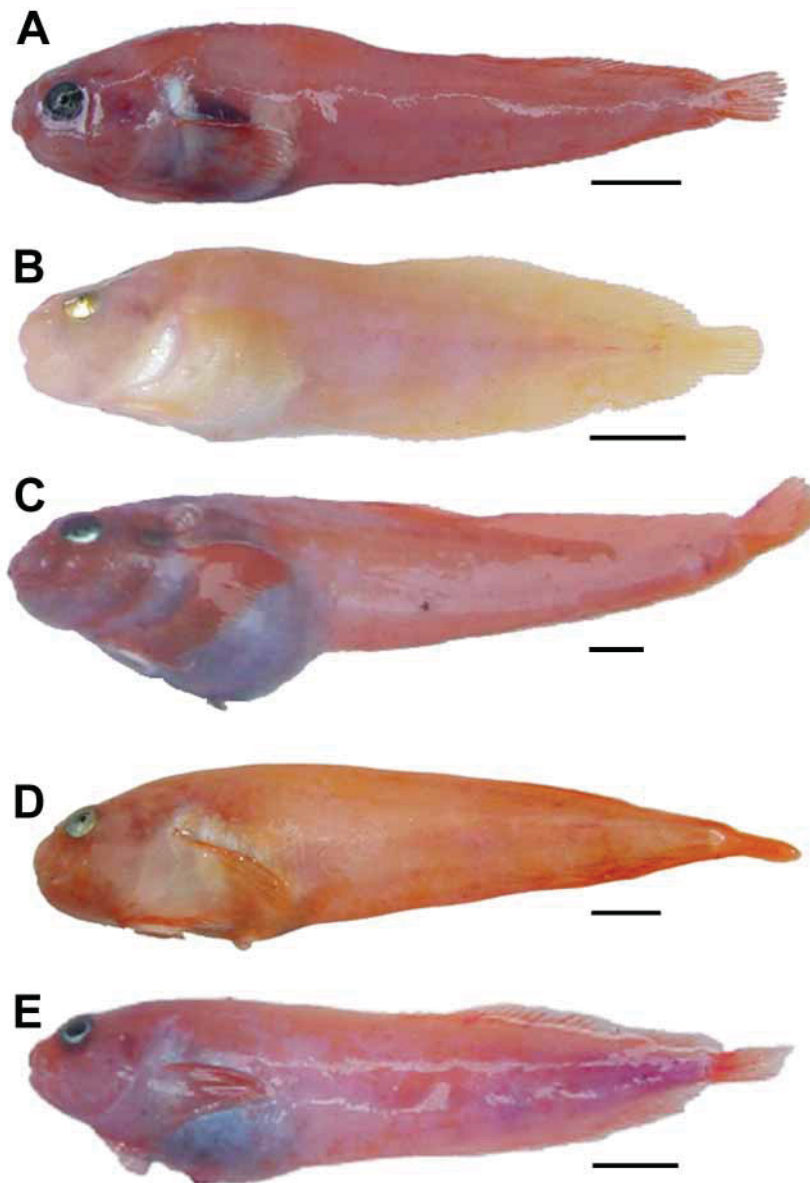


FIGURE 1. Species of *Allocareproctus*: A) *A. jordani*, UW 112283, 74.8 mm, male; B) *A. tanix*, UW 112294, holotype, 65.6 mm, male; C) *A. kallaion*, UW 112244, holotype, 157.0 mm, female; D) *A. unangas*, UW 112308, holotype, 82.5 mm, female; E) *A. ungak*, UW 111933, holotype, 91.0 mm, female. Scale bar = 10 mm.

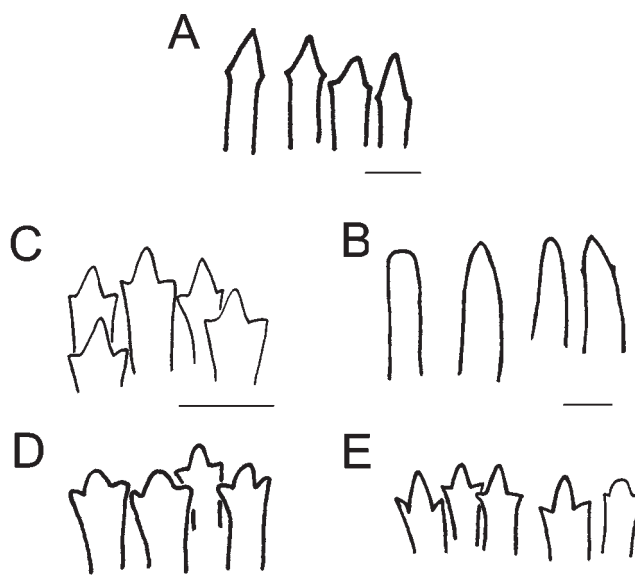


FIGURE 2. Teeth of species of *Allocareproctus*: A) *A. jordani*, UW 112283, 17 mm HL; B) *A. tanix*, UW 113166, paratype, 17.8 mm HL; C) *A. kallaion*, UW 112236, paratype, 31.4 mm HL; D) *A. unangas*, UW 112088, paratype, 22 mm HL; E) *A. ungak*, UW 45239, paratype, 22 mm HL. Scale bar = 0.25 mm.

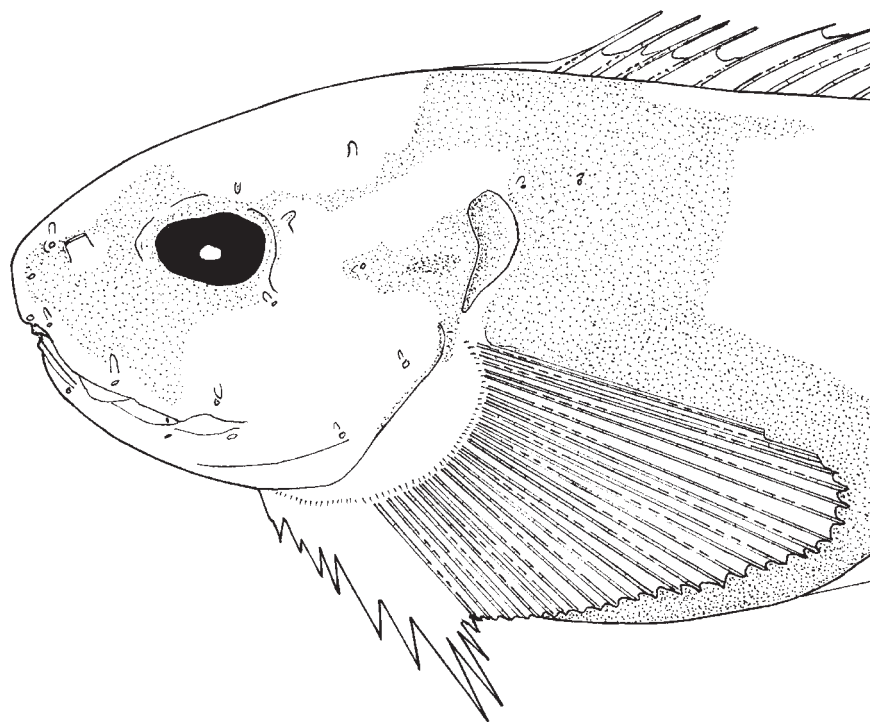


FIGURE 3. *Allocareproctus kallaion*, UW 112244, holotype, 157 mm, female. Head and anterior portion of body showing papillae associated with cephalic pores and exerted tips of anterior dorsal-fin rays. Illustration by B.M. Vinter.

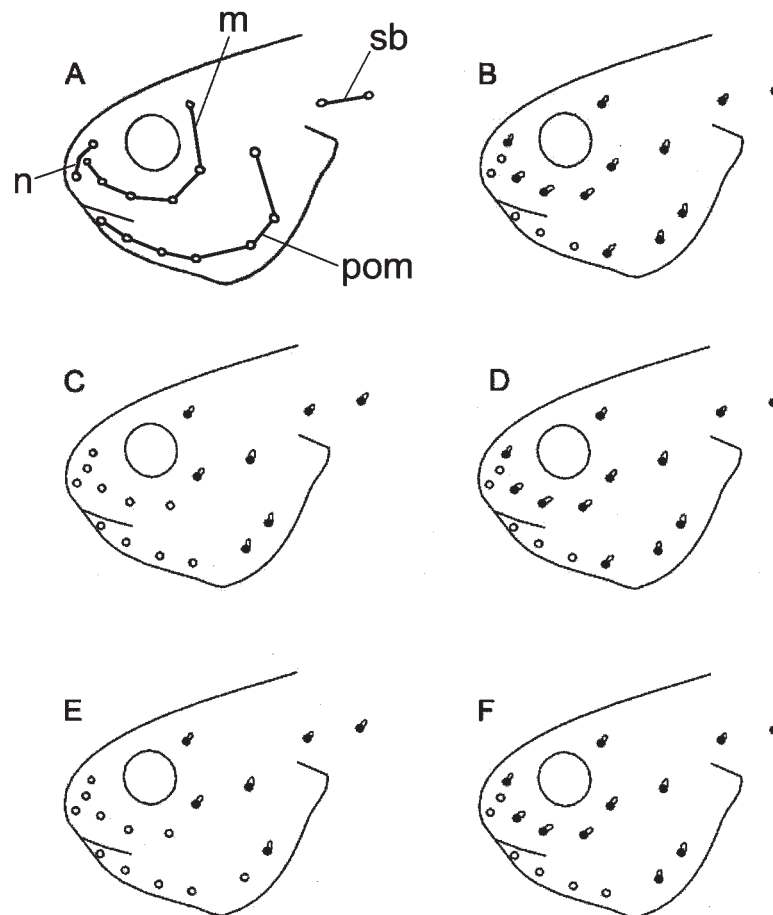


FIGURE 4. Diagram of cephalic pores and distribution of associated papillae in species of *Allocareproctus*: A) Cephalic pore series in *Allocareproctus*; B) *A. jordani*; C) *A. tanix*; D) *A. kallaion*; E) *A. unangas*; F) *A. ungak*. n = nasal; m = maxillary; pom = preoperculo-mandibular; sb = suprabranchial.

Pectoral-fin rays 33–42 (Table 1). Pectoral fin shallowly notched (Figs. 2, 5), with upper lobe of 24–33 rays extending to about anal-fin origin, dorsalmost rays lengthening to rays 5–7, more ventral rays gradually shortening to shortest ray of notch; lower lobe moderate, with 8–10 rays, extending to between pelvic disk and anus or slightly posterior, dorsal rays gradually lengthening to rays 3–4, more ventral rays gradually shortening to ventralmost ray near pectoral symphysis. Tips of rays 6–20% free of membrane, lower rays more strongly exerted. Rays in notch slightly more widely spaced than rays of lobes. Uppermost pectoral-fin ray level with area between ventral rim of orbit and maxilla. Lowermost pectoral-fin ray below posterior rim of orbit or slightly posterior to posterior rim. Pectoral radials 4 (3+1), robust, notched. Interradial fenestrae three (Fig. 6).

Pelvic disk large, 30–45% HL, round, slightly wider than long, anterior lobe well developed, flat with margins often slightly upturned. Anus closer to pelvic disk than to anal-fin origin. Principal caudal fin rays 11–14 (Table 1), dorsal procurent rays 1–3,

ventral procurent rays 1–2. Posterior dorsal-fin rays overlapping caudal fin 15–40% CL; posterior anal-fin rays, 20–50% CL. Skin thin, fragile, prickles absent. Pyloric caeca thick, length about 15–50% HL.

Vertebrae 45–50, 9–12 precaudal, 33–40 caudal (Table 2). Pleural ribs present on vertebrae 8–10, long and slender. Hypural plate composed of dorsal and ventral plates, divided by deep split about 75% length of plate. Epurals 1–2.

Body pale, red to orange, with darker anterior portions in some species (Fig. 1). Peritoneum and orobranchial cavity pale or black; stomach, intestines, pyloric caeca, and urogenital papilla pale.

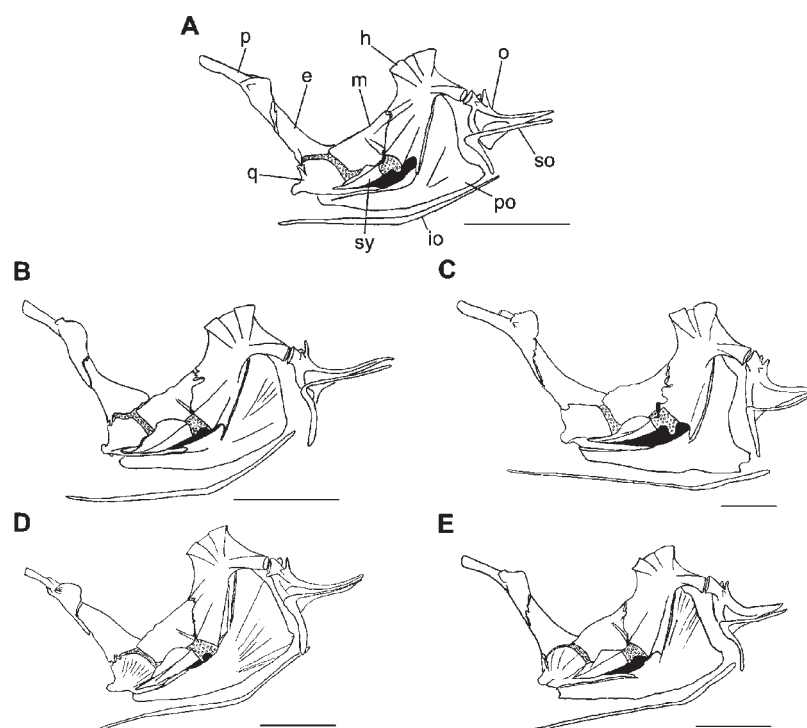


FIGURE 5. Suspensoria of species of *Allocareproctus*: A) *A. jordani*, UW 112283, 17 mm HL; B) *A. tanix*, UW 113166, paratype, 17.8 mm HL; C) *A. kallaion*, UW 112236, paratype, 31.4 mm HL; D) *A. unangas*, UW 112088, paratype, 22 mm HL; E) *A. ungak*, UW 45239, paratype, 22 mm HL. Scale bar = 5 mm. p = palatine, e = ectopterygoid, m = metapterygoid, h = hyomandibula, o = opercle, so = subopercle, po = preopercle, io = interopercle, sy = symplectic, q = quadrate.

Range

The genus *Allocareproctus* has been collected from Sagami Bay, Japan, the Kuril Islands, the eastern Sea of Okhotsk (Vinnikov & Novikov 2004), southern Kamchatka (Sheiko & Fedorov 2000; Tokranov 2000), the Aleutian Islands from Kiska Island to the Islands of Four Mountains, and to just south of the Pribilof Islands in the southeastern Bering Sea (Figs. 7–11). The species range in depths from 75 to 621 m.

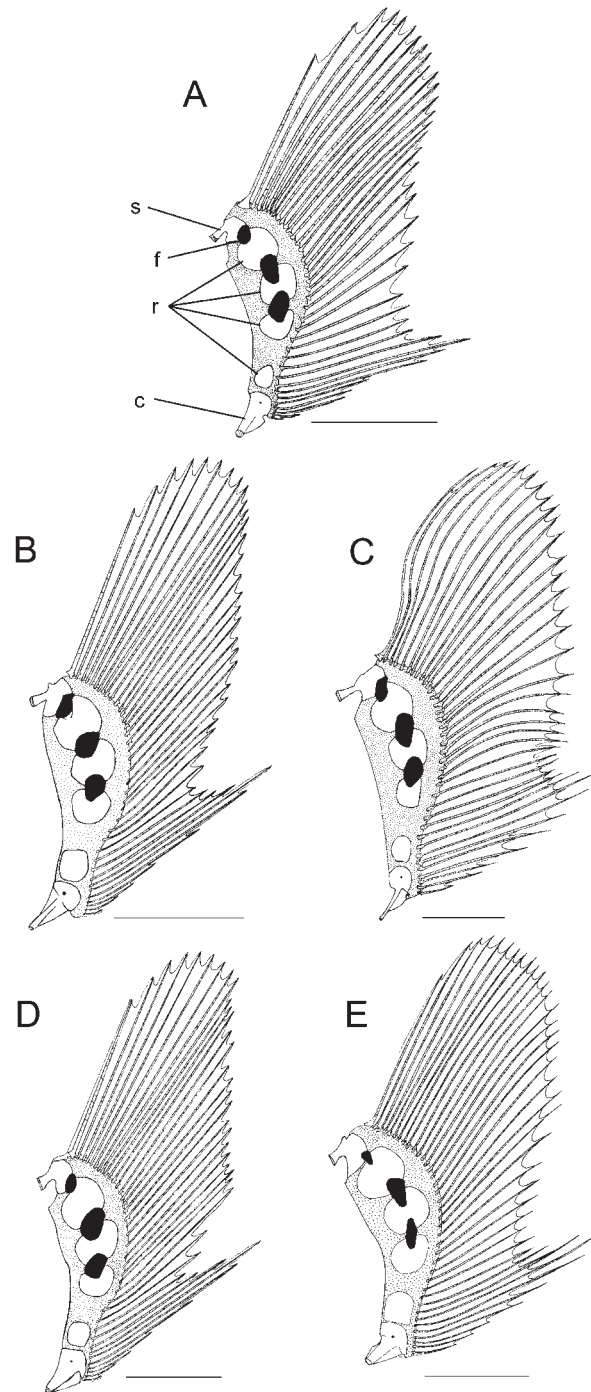


FIGURE 6. Pectoral girdles of species of *Allocareproctus*: A) *A. jordani*, UW 112283, 74.2 mm; B) *A. tanix*, UW 113166, paratype, 63.8 mm; C) *A. kallaion*, UW 112236, paratype, 129.0 mm; D) *A. unangas*, UW 112088, paratype, 84.2 mm; E) *A. ungak*, UW 45239, paratype, 84.5 mm. Scale bar = 5 mm. c = coracoid, f = interradian fenestra, r = radial, s = scapula. Illustrations by B.M. Vinter.

TABLE 1. Counts of dorsal-, anal-, pectoral-, and caudal-fin rays in species of *Allocareproctus*.

| Species | Dorsal-fin rays | | | | | | | <i>n</i> |
|--------------------|-----------------|----|----|----|----|----|----|----------|
| | 39 | 40 | 41 | 42 | 43 | 44 | 45 | |
| <i>A. jordani</i> | | | 5 | 21 | 17 | 8 | 3 | 54 |
| <i>A. tanix</i> | | | 3 | 1 | | | | 4 |
| <i>A. kallaion</i> | | | | 8 | 18 | 6 | 2 | 34 |
| <i>A. unangas</i> | | | | 8 | 16 | 6 | 3 | 33 |
| <i>A. ungak</i> | 1 | 15 | 18 | 6 | | | | 40 |

| Species | Anal-fin rays | | | | | | | <i>n</i> |
|--------------------|---------------|----|----|----|----|----|----|----------|
| | 33 | 34 | 35 | 36 | 37 | 38 | 39 | |
| <i>A. jordani</i> | 1 | 2 | 11 | 30 | 9 | 1 | | 54 |
| <i>A. tanix</i> | | 1 | 1 | 2 | | | | 4 |
| <i>A. kallaion</i> | 1 | 2 | 15 | 14 | 2 | | | 34 |
| <i>A. unangas</i> | | | | 5 | 21 | 5 | 2 | 33 |
| <i>A. ungak</i> | 2 | 18 | 20 | | | | | 40 |

| Species | Principal caudal-fin rays | | | | | <i>n</i> |
|--------------------|---------------------------|----|----|----|----|----------|
| | 11 | 12 | 13 | 14 | | |
| <i>A. jordani</i> | 10 | 35 | 6 | | 51 | |
| <i>A. tanix</i> | | 3 | 1 | | 4 | |
| <i>A. kallaion</i> | 3 | 26 | 4 | 1 | 34 | |
| <i>A. unangas</i> | 2 | 30 | | | 32 | |
| <i>A. ungak</i> | 1 | 34 | 3 | | 38 | |

| Species | Pectoral-fin rays | | | | | | | | | | <i>n</i> |
|--------------------|-------------------|----|----|----|----|----|----|----|----|----|----------|
| | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | |
| <i>A. jordani</i> | 1 | 5 | 13 | 22 | 7 | 3 | 3 | | | | 54 |
| <i>A. kallaion</i> | | | | 6 | 6 | 12 | 8 | 1 | | | 33 |
| <i>A. tanix</i> | | | | | | 3 | 1 | | | | 4 |
| <i>A. unangas</i> | | | | | | 11 | 9 | 5 | 6 | 2 | 33 |
| <i>A. ungak</i> | | | 3 | 9 | 10 | 6 | 8 | 3 | | | 39 |

Etymology

“Allo” from the Greek “αλλο”, meaning “other”, and “*Careproctus*”, from the Greek “καρρ”, meaning “head”, and “πρωκτος”, meaning “anus” (Pitruk & Fedorov 1993).

TABLE 2. Counts of abdominal and caudal vertebrae and gill rakers in species of *Allocareproctus*.

| Abdominal vertebrae | | | | | |
|---------------------|---|----|----|----|----------|
| Species | 9 | 10 | 11 | 12 | <i>n</i> |
| <i>A. jordani</i> | | 1 | 51 | 3 | 55 |
| <i>A. tanix</i> | 1 | 3 | | | 4 |
| <i>A. kallaion</i> | | | | 34 | 34 |
| <i>A. unangas</i> | | 27 | 6 | | 33 |
| <i>A. ungak</i> | | 26 | 14 | | 40 |

| Caudal vertebrae | | | | | | | | | |
|--------------------|----|----|----|----|----|----|----|----|----------|
| Species | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | <i>n</i> |
| <i>A. jordani</i> | | | 5 | 26 | 16 | 8 | | | 55 |
| <i>A. tanix</i> | | | 1 | 1 | 2 | | | | 4 |
| <i>A. kallaion</i> | 1 | 2 | 12 | 16 | 3 | | | | 34 |
| <i>A. unangas</i> | | | | 3 | 12 | 14 | 2 | 2 | 33 |
| <i>A. ungak</i> | | 5 | 24 | 11 | | | | | 40 |

| Gill rakers | | | | | | | | | | | | | |
|--------------------|---|----|----|----|----|----|----|----|----|----|----|----|----------|
| Species | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | <i>n</i> |
| <i>A. jordani</i> | | 2 | 10 | 23 | 16 | 3 | | | | | | | 54 |
| <i>A. tanix</i> | | | 1 | 3 | | | | | | | | | 4 |
| <i>A. kallaion</i> | | | | | | | | 3 | 7 | 8 | 12 | 3 | 33 |
| <i>A. unangas</i> | | 7 | 15 | 6 | 3 | 2 | | | | | | | 33 |
| <i>A. ungak</i> | 3 | 10 | 10 | 13 | 4 | | | | | | | | 40 |

Comparisons

Pitruk & Fedorov (1993) suggested the similarity of *Pseudonotoliparis* and *Temnocora* to *Allocareproctus* based on elongate anterior rays of the dorsal fin. In the illustration and original description of *Pseudonotoliparis*, however, the anterior dorsal-fin rays appear to be only slightly exserted from the membrane, similar to many species of liparids but dissimilar to *Allocareproctus*. In *Temnocora*, the anterior rays form a small lobe in which the tips are slightly free from the membrane, similar to that of *Lopholiparis flerxi* (Orr 2004) and undescribed species of *Careproctus* from the Aleutians (Orr in prep.). This condition is also unlike that of the anterior rays of *Allocareproctus*, which gradually lengthen from anterior to posterior and are up to 50% free of the membrane in the anteriormost rays. We identified the first lot of *Allocareproctus* from the Aleutians in a collection that also contained the holotype of *Prognatholiparis ptychomandibularis* Orr & Busby. *Prognatholiparis* is similar in general body morphology and body color but is readily distinguished by its lack of exserted dorsal-fin rays, and presence of a protruding

lower jaw and strong folds around the cephalic pores on the jaws. All of these genera lack the papillae found in all species of *Allocareproctus*.

Several other species have been compared with and considered allied to *A. jordani*, and thus *Allocareproctus*, by Kido (1985, 1988). These include *Careproctus pycnosoma* Gilbert & Burke, *C. curilanus* Gilbert & Burke, *C. ectenes* Gilbert, and *C. attenuatus* Gilbert & Burke. All lack papillae on the cephalic pores. Although the types of these species are small (39–64 mm) and are probably juveniles, even our smallest specimens of *Allocareproctus* (40.3–60.0 mm) possess well-developed papillae.

Among these species, *C. pycnosoma* is most similar to *Allocareproctus*, and based on our examination of Kido's (1985) material, his *C. pycnosoma* (HUMZ 88509) represents one of our new species described below. As well as lacking papillae, the holotype of *C. pycnosoma* has a more slender body than all species of *Allocareproctus*. While the head and body shapes of *C. pycnosoma* are somewhat similar to *Allocareproctus*, both *C. ectenes* and *C. curilanus* have strongly protruding snouts and attenuate bodies, with much higher median fin and vertebral counts than in all species of *Allocareproctus*. The anterior dorsal-fin rays of *C. pycnosoma* and *C. curilanus* were originally described as exserted (Gilbert & Burke 1912), similar to the condition in *Allocareproctus*. Although the condition of the holotypes of these species is good for their age, the membranes of the dorsal fin are damaged, and therefore we are unable to assess their original condition. In *C. ectenes*, the anterior rays are exserted, yet differ in that dorsal-fin rays 2–3 are longer than the other rays; in adults these anterior rays develop into an elongate anterior lobe. The holotype and only known specimen of *C. attenuatus* (Mecklenburg *et al.* 2002) is in poor condition and at least the anteriormost three dorsal-fin rays are missing. The fourth ray is proportionally the same length indicated in the illustration of the holotype (about 30% HL, Gilbert & Burke 1912). Only three other liparids in two genera possess cephalic papillae or barbels (Kido, 1985): *Odontoliparis ferox* Stein, *Rhinoliparis attenuatus* Burke, and *R. barbifer* Gilbert. All these species lack a pelvic disk and are thus apparently unrelated to *Allocareproctus*, and in both genera, the papillae are different from the condition in *Allocareproctus*. In *Odontoliparis*, the papillae are large and robust on the midline of the snout and between maxillary and mandibular pores (Stein 1978), unlike the small papillae of *Allocareproctus* that are found on pore margins. Smaller papillae are also scattered “in no discernible pattern” over the head in *Odontoliparis* (Stein 1978:34). In *Rhinoliparis*, the barbels around the mouth are long and not directly associated with pores.

Key to species of *Allocareproctus*

- 1A. Teeth trilobed, nearly all with moderate to strong lateral lobes; peritoneum pale or dark; nasal papilla present and unpigmented or absent..... 2
- 1B. Teeth simple, often with weak shoulders; peritoneum dark; nasal papilla present, pigmented..... 4

- 2A. Peritoneum pale; nasal papilla absent; interorbital papilla absent; Aleutian Islands: Kiska Island to the Islands of Four Mountains *Allocareproctus tanix* n. sp.
- 2B. Peritoneum dark; nasal papilla present or absent; interorbital papilla present or absent 3
- 3A. Nasal papilla absent; anal-fin rays 36–39; interorbital papilla present; papillae on maxillary pores 5–6 or 6 only; Aleutian Islands: Buldir Island to the Islands of Four Mountains *Allocareproctus unangas* n. sp.
- 3B. Nasal papilla present; anal-fin rays 33–35; interorbital papilla present or absent; papillae on maxillary pores 4–6 or more; Aleutian Islands: Segoum Island to the Islands of Four Mountains *Allocareproctus ungak* n. sp.
- 4A. Orobuccal cavity dark; orobuccal valve with 4–6 finger-like projections; gill rakers 14–18; abdominal vertebrae 12; anterior part of body dark; interorbital papilla absent; Aleutian Islands: Segoum Island to the Islands of Four Mountains *Allocareproctus kallaion* n. sp.
- 4B. Orobuccal cavity pale; orobuccal valve with 1 finger-like projection; gill rakers 8–12; abdominal vertebrae 10–12; anterior part of body pale; interorbital papilla present or absent; Aleutian, Pribilof, and Kuril Islands; Japan *Allocareproctus jordani* (Burke)

***Allocareproctus jordani* (Burke 1930)**

Cherry Snailfish

(Figures 1–2, 4–7, 12–13; Tables 1–4)

Careproctus gilberti Jordan & Thompson 1914:282, pl. 34, figs. 1, 1a (original description from Sagami Bay, junior primary homonym of *C. gilberti* Burke 1912).

Careproctus jordani Burke 1930:192 (replacement name, redescription); Okada & Matsubara 1938:347 (checklist and keys); Matsubara 1955:1194 (checklist and keys); Kido 1984:339, pl. 365 (brief description); Kido 1988:197, pl. 36 (review, phylogenetics of Liparidae); Pitruk 1990:37 (review, phylogenetics of Liparidae); Nakabo 2000:669, 2002:669 (checklist and keys).

Allocareproctus jordani Pitruk & Fedorov 1993:17, figs. 1–5 (new genus, redescription); Sheiko & Fedorov 2000:31 (possible synonym of “*Allocareproctus*” *pycnosoma*); Orr & Busby 2001:56 (in part; compared to *Prognatholiparis ptychomandibularis*); Chernova *et al.* 2004:3 (checklist).

Material examined

FMNH 57514, 130.0 mm, holotype, Misaki, Sagami Bay, Japan; UW 112293, 1 (142 mm), 52.3687°N, 171.2406°W, 323 m depth, 31 May 2000, M/V *Dominator*, cruise 2000-01, haul 51, J.W. Orr; UW 112286, 1(139.3 mm), 52.0532°N, 171.8035°W, 331 m depth, 6 August 2002, F/V *Sea Storm*, cruise 2002-01, haul 209; UW 112284, 1(150 mm), Kuril Islands, 16 September 2000, haul 93, A.M. Orlov; UW 112287, 1(173 mm), Kuril Islands, 22 Sep 2000, haul 114, 47.9667°N, 154.6167°E, 390 m depth, 22 September 2000, A.M. Orlov; UW 112282, 11(74–86 mm), 52.331°N, 172.7470°W, 441 m depth, 23 July 2002, F/V *Sea Storm*, cruise 2002-01, haul 156, J.W. Orr; UW 112285, 1(105 mm), 52.3217°N,

172.7447°W, 458 m depth, 16 June 1994, F/V *Pacific Knight*, cruise 1994-01, haul 54; UW 112283, 14(53.3–85.2 mm; 74.2 mm cleared and stained), 52.3405°N, 172.7455°W, 441 m depth, 31 May 2002, F/V *Morning Star*, cruise 2002-01, haul 32, J.W. Orr; UW 112280, 2(130–137.7 mm), 52.3732°N, 171.3548°W, 324 m depth, 10 August 2002, F/V *Sea Storm*, cruise 2002-01, haul 225, R.C. Harrison; UW 112291, 2(63.2–132 mm), 52.3687°N, 171.2406°W, 323 m depth, 31 May 2002, M/V *Dominator*, cruise 2000-01, haul 51, benthic bag, J.W. Orr; UW 112288, 2(126.5–136.5 mm), 56.1354°N, 169.4400°W, 631 m depth, 15 July 2002, F/V *Morning Star*, cruise 2002-02, haul 119; ZIN 49891, 1(149.5 mm), Kuril Is., Shimushir I., 47.5°N, 153°E, 350 m depth, A. A. Balanov; UW 112290, 1(47 mm), 52.2103°N, 172.2066°W, 359 m depth, 4 June 2000, M/V *Dominator*, cruise 2000-01, haul 74, benthic bag, J.W. Orr; UW 112281, 2(69.2–79 mm), 52.2099°N, 172.2057°W, 348 m depth, 23 July 2002, F/V *Sea Storm*, cruise 2002-01, haul 157, J.W. Orr; UW 112279, 7(54–104.3 mm), 52.3282°N, 172.7468°W, 444 m depth, 4 June 2000, F/V *Vesteraalen*, cruise 2000-01, haul 67, W.C. Flerx; UW 112289, 2(54–104.3 mm), 52.3184°N, 172.7453°W, 455 m depth, 22 June 1997, F/V *Vesteraalen*, cruise 1997-01, haul 58, W.C. Flerx; UW 112292, 1(145 mm), 52.2754°N, 170.5991°W, 235 m depth, 14 June 2004, F/V *Sea Storm*, cruise 2004-01, haul 34, J.W. Orr; UW 113693, 1(150 mm), 52.2102°N, 172.2060°W, 341 m depth, 23 June 2004, F/V *Sea Storm*, cruise 2004-01, haul 73, J.W. Orr; UW 113697, 20(51–117 mm), 52.3255°N, 172.7466°W, 450 m depth, 19 June 2004, F/V *Sea Storm*, cruise 2004-01, haul 60, benthic bag, J.W. Orr; UW 113685, 1(128 mm), 51.4514°N, 178.6024°E, 382 m depth, 21 July 2004, F/V *Gladiator*, cruise 2004-01, haul 174, R.N. Clark; UW 113686, 2(118–125 mm), 56.1430°N, 169.4567°W, 625 m depth, 20 June 2004, F/V *Northwest Explorer*, cruise 2004-01, haul 57, D.E. Stevenson; UW 25139, 1(145 mm), southern Bering Sea, May 1981; UW 113687, 1(125 mm), 56.1913°N, 169.4864°W, 478 m depth, 29 July 2004, F/V *Northwest Explorer*, cruise 2004-01, haul 158, J.W. Orr.

Diagnosis

Teeth simple or with weak shoulders (Fig. 2A); nasal pore 1 with pigmented papilla; peritoneum black; orobuccal valve with single finger-like projection (Fig. 12A); orobuccal cavity pale; gill rakers 8–12, short, blunt; interorbital papilla present or absent; pyloric caeca on right side; body red; iris silver gray.

Description

Body depth at pectoral-fin base 13.0–19.4 (15.0)%, at center of pelvic disk 15.4–21.9 (15.4)%, at anal-fin origin 17.6–23.7 (18.9)%. Predorsal length 24.4–30.1 (27.9)%. Preanal length 37.4–44.5 (43.9)%.

Head large, width 11.8–19.2 (14.6)%, length 22.9–27.5 (25.8)%. Interorbital width 4.5–8.3 (5.2)%. Snout 6.0–9.1 (8.1)%. Mouth small, maxilla length 8.3–13.0 (11.3)%, extending to anterior portion of orbit. Teeth simple, often with weak shoulders (Fig. 2A), in a band of 7–11 oblique rows of 5–9 teeth per row. Orbit large, diameter 5.6–7.3 (6.6)%.

TABLE 3. Proportional morphometric characters in percent standard length and meristic characters for specimens of *Allocaeproctus jordani* and selected type material of new species used for statistical analyses. Range, with mean \pm standard deviation below in parentheses. Differences were considered significant at $P < 0.01$. "X" = significant difference between one or more species pairs. "NS" = nonsignificant. "—" indicates the character was not analyzed because it failed to meet statistical assumptions.

| | <i>A. jordani</i> | <i>A. tanix</i> | <i>A. unangas</i> | <i>A. kallaion</i> | <i>A. ungak</i> | Significance |
|--|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------|
| <i>n</i> | 34 | 4 | 30 | 30 | 30 | |
| Standard length (mm) | 53.3–173.0 | 45.8–77.6 | 40.3–129.7 | 67.8–195 | 55–129.3 | |
| Head length | 22.2–27.5 (24.6 \pm 1.1) | 26.3–29.7 (27.8 \pm 1.4) | 25.1–28.2 (26.5 \pm 0.8) | 21.7–24.3 (23.2 \pm 0.7) | 23.9–27.3 (25.8 \pm 0.8) | X |
| Head width | 11.8–19.2 (14.9 \pm 1.7) | 12.4–16.8 (14.5 \pm 1.8) | 12.7–18.8 (14.9 \pm 1.4) | 12.4–19.6 (14.0 \pm 1.6) | 11.8–20.4 (14.6 \pm 1.6) | — |
| Depth at anal-fin origin | 17.6–23.7 (20.2 \pm 1.4) | 23.3–25.3 (24.2 \pm 0.9) | 18.8–26.5 (22.7 \pm 1.8) | 14.0–22.0 (18.4 \pm 1.7) | 18.2–25.2 (21.6 \pm 1.7) | X |
| Depth from dorsal-fin to anal-fin origin | 21.6–29.3 (25.9 \pm 1.8) | 27.3–30.8 (29.2 \pm 1.5) | 22.4–31.3 (27.2 \pm 1.8) | 22.1–31.0 (26.4 \pm 2.2) | 24.1–30.0 (26.8 \pm 1.6) | X |
| Depth at pectoral-fin base | 13.0–19.4 (16.4 \pm 1.7) | 17.8–23.0 (20.6 \pm 2.1) | 14.2–22.6 (18.5 \pm 1.8) | 11.8–18.6 (15.0 \pm 1.5) | 15.0–21.0 (17.7 \pm 1.6) | X |
| Depth at pelvic disk | 15.4–23.3 (18.8 \pm 1.8) | 19.5–24.5 (21.6 \pm 2.1) | 18.9–24.6 (21.2 \pm 1.5) | 13.8–21.2 (17.5 \pm 1.7) | 16.6–22.9 (20.0 \pm 1.7) | X |
| Snout length | 6.0–9.1 (7.2 \pm 0.8) | 7.7–9.2 (8.4 \pm 0.7) | 6.5–9.2 (7.9 \pm 0.6) | 5.5–8.8 (7.3 \pm 0.7) | 6.8–9.3 (7.8 \pm 0.6) | X |
| Orbit length | 5.6–7.3 (6.5 \pm 0.5) | 6.4–7.1 (6.8 \pm 0.3) | 5.0–7.8 (6.6 \pm 0.6) | 5.3–7.3 (6.3 \pm 0.5) | 5.2–7.0 (6.3 \pm 0.4) | X |
| Interorbital width | 4.5–8.3 (6.4 \pm 1.1) | 5.5–6.4 (5.9 \pm 0.4) | 5.1–8.2 (6.4 \pm 0.6) | 4.3–7.7 (5.9 \pm 1.0) | 4.9–8.0 (6.5 \pm 0.6) | NS |
| Suborbital depth to oral cleft | 2.1–3.8 (3 \pm 0.5) | 3.5–4.7 (4.1 \pm 0.6) | 1.7–4.8 (3.3 \pm 0.7) | 1.9–4.4 (2.9 \pm 0.5) | 2.2–4.5 (3.1 \pm 0.5) | X |
| Suborbital depth to mandible | 5.1–7.9 (6.5 \pm 0.7) | 7.7–8.3 (8.0 \pm 0.3) | 5.9–7.9 (6.9 \pm 0.6) | 4.6–7.2 (5.9 \pm 0.6) | 5.0–8.4 (6.5 \pm 0.8) | X |
| Mouth width | 11.2–15.8 (13.5 \pm 1.2) | 11.8–14.2 (13.4 \pm 1.1) | 11.1–15.8 (13.1 \pm 1.1) | 4.6–15.4 (12.8 \pm 1.8) | 10.6–15.8 (12.9 \pm 1.3) | — |
| Maxilla length | 8.3–13.0 (10.0 \pm 1.0) | 10.8–12 (11.5 \pm 0.5) | 8.4–12.0 (10.8 \pm 0.8) | 7.5–11.3 (9.9 \pm 0.8) | 9.0–12.1 (10.2 \pm 0.6) | — |
| Mandible length | 7.4–14.2 (10.8 \pm 1.3) | 10.7–12.0 (11.5 \pm 0.6) | 8.2–13.0 (11.4 \pm 0.9) | 9.9–12.1 (11.0 \pm 0.5) | 10.0–12.3 (11.3 \pm 0.6) | — |
| Gill-slit length | 3.7–8.7 (5.3 \pm 1.0) | 4.9–7.1 (6.3 \pm 1.0) | 4.7–7.1 (6.0 \pm 0.6) | 4.6–6.7 (5.6 \pm 0.6) | 4.9–7.8 (6.3 \pm 0.7) | — |

to be continued

TABLE 3 (continued).

| | <i>A. jordani</i> | <i>A. tanix</i> | <i>A. unangas</i> | <i>A. kallaion</i> | <i>A. ungak</i> | Significance |
|---|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|--------------|
| <i>n</i> | 34 | 4 | 30 | 30 | 30 | |
| Upper pectoral-fin length | 15.7–19.7 (17.9±0.9) | 18.0–20.7 (19.2±1.2) | 15.4–20.1 (18.3±1.0) | 15.8–20.1 (17.7±1.1) | 16.0–20.0 (17.8±0.9) | NS |
| Lower pectoral-fin length | 12.0–19.0 (15.7±1.6) | 16.6–19.9 (17.8±1.4) | 13.4–19.5 (16.6±1.5) | 13.3–20.2 (15.7±1.4) | 14.4–19.8 (16.6±1.4) | — |
| Pectoral-fin notch-ray length | 5.3–11.2 (7.6±1.4) | 9.0–10.0 (9.5±0.4) | 4.9–14.2 (8.4±1.7) | 4.6–9.5 (7.4±1.2) | 5.8–10.5 (8.0±1.3) | — |
| Predorsal length | 24.4–30.1 (27.0±1.4) | 29.0–34.5 (32.0±2.3) | 26.5–33.3 (29.6±1.3) | 22.7–28.6 (25.8±1.3) | 25.9–29.7 (27.8±1.1) | X |
| Preanal length | 37.4–44.5 (41.0±1.7) | 40.6–48.0 (45.0±3.3) | 37.4–46.4 (42.1±2.3) | 38.8–47.0 (42.9±1.8) | 38.4–47.3 (42.2±2) | NS |
| Snout to pelvic disk length | 12.4–16.9 (15.3±1.0) | 16.8–20.1 (18.5±1.4) | 14.3–20 (16.9±1.4) | 12.5–16.2 (14.1±0.9) | 14.8–24.1 (17.2±2) | — |
| Snout to anus length | 25.5–32.9 (29.2±1.5) | 30.3–36.9 (33.8±2.8) | 28.3–33.8 (31.2±1.5) | 24.9–31.6 (28.1±1.5) | 25.6–34.7 (29.8±1.8) | X |
| Mandible to pelvic disk length | 10.7–14.4 (12.9±0.9) | 13.4–16.4 (14.6±1.3) | 12.7–17.1 (14.6±1.1) | 10.9–13.9 (12.2±0.7) | 12.6–21.4 (15.1±1.7) | — |
| Mandible to anus length | 24.8–31.2 (27.6±1.6) | 28.5–33.6 (30.8±2.1) | 15.1–33.7 (29±3.7) | 17.6–30.2 (26.5±2.3) | 25.3–33.1 (28.3±1.8) | — |
| Pelvic disk length | 8.5–11.1 (9.7±0.6) | 9.9–11.6 (10.7±0.7) | 7.81–1.4 (9.8±0.7) | 8.0–9.7 (8.7±0.4) | 8.6–11.8 (9.9±0.8) | X |
| Pelvic disk width | 7.9–10.7 (9.0±0.6) | 9.0–11.1 (9.7±0.9) | 7.4–10.7 (8.9±0.8) | 7.1–8.8 (8.0±0.4) | 7.1–11.1 (9.2±0.9) | X |
| Pelvic disk to anus length | 2.6–7.0 (5.0±1.0) | 4.7–7.6 (5.9±1.3) | 1.7–8.3 (5.3±1.2) | 2.7–9.4 (6.1±1.5) | 1.5–5.5 (3.4±1.0) | X |
| Anus to anal-fin length | 9.0–16.9 (12.1±1.8) | 10.6–15.2 (13.2±2.0) | 5.7–15.8 (11.3±2.1) | 11.6–18.9 (15.7±1.8) | 6.7–18.8 (13.0±2.2) | — |
| Caudal-fin length | 11.7–15.6 (14.3±0.9) | 14.6–17.4 (15.8±1.2) | 11.7–17.0 (14.3±1.2) | 12.8–17.1 (15.2±0.9) | 13.0–17.1 (14.8±0.9) | — |
| Length of dorsal-fin connection to caudal fin | 1.8–5.3 (3.4±0.8) | 3.3–6.6 (5.0±1.4) | 2.5–5.0 (3.8±0.6) | 2.0–4.4 (2.9±0.6) | 2.3–5.8 (4.0±0.9) | X |
| Length of anal-fin connection to caudal fin | 2.6–5.3 (3.9±0.7) | 4.1–6.9 (5.7±1.4) | 3.0–5.3 (4.3±0.7) | 2.6–5.1 (3.9±0.6) | 3.0–5.9 (4.8±0.7) | X |
| Caudal-fin base depth | 3.1–4.8 (3.6±0.4) | 3.7–5.2 (4.1±0.7) | 2.4–5.2 (3.7±0.6) | 2.7–4.6 (3.6±0.4) | 3.3–5.2 (4.3±0.5) | — |

to be continued

TABLE 3 (continued).

| | <i>A. jordani</i> | <i>A. tanix</i> | <i>A. unangas</i> | <i>A. kallaion</i> | <i>A. ungak</i> | Significance |
|---------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|--------------|
| <i>n</i> | 34 | 4 | 30 | 30 | 30 | |
| Meristics | | | | | | — |
| Dorsal-fin rays | 41–45 (42.9±1.0) | 41–42 (41.3±0.5) | 42–45 (43.1±0.9) | 42–45 (43.1±0.9) | 39–42 (40.8±0.8) | X |
| Anal-fin rays | 34–38 (36.1±0.8) | 34–36 (35.3±1.0) | 36–39 (37.1±0.8) | 34–37 (35.5±0.7) | 33–35 (34.4±0.6) | X |
| Pectoral-fin rays | 34–39 (36.1±1.2) | 38–39 (38.3±0.5) | 38–42 (39.4±1.3) | 36–40 (37.9±1.1) | 35–40 (37.4±1.5) | X |
| Principal caudal-fin rays | 11–13 (12.0±0.6) | 12–13 (12.3±0.5) | 11–12 (11.9±0.3) | 11–14 (12.1±0.6) | 12–13 (12.1±0.3) | — |
| Abdominal vertebrae | 10–12 (11.1±0.3) | 9–10 (9.8±0.5) | 10–11 (10.2±0.4) | 12–12 (12.0±0.0) | 10–11 (10.4±0.5) | — |
| Caudal vertebrae | 35–38 (36.6±0.9) | 35–37 (36.3±1.0) | 36–40 (37.6±1.0) | 33–37 (35.6±0.9) | 34–36 (35.1±0.6) | X |
| Gill rakers on first arch | 8–12 (10.2±0.9) | 9–10 (9.75±0.5) | 8–12 (9.3±1.0) | 14–18 (16.3±1.1) | 7–11 (9.0±1.1) | X |

Papillae present on many pores: present on nasal pore 1, absent from nasal pore 2; present on maxillary pores 4–6, often present on pores 2–3 (4–6); present on preoperculo-mandibular pores 5–6, often present also on pores 4 and 7 (6–7); present on suprabranchial pores 1–2 (Fig. 4B). Interorbital papilla present or absent (present in holotype). Cephalic free neuromasts profuse and relatively large, scattered evenly over interorbit and nape.

Gill opening small, 3.7–8.7 (5.3)%, entirely above pectoral fin or extending to pectoral-fin ray 2. Gill rakers on anterior arch 8–12 (ca. 10, gill slit of holotype not dissected), blunt and stout. Central projection of orobuccal valve a moderately elongate single lobe (Fig. 12A).

Dorsal-fin rays 41–45 (44), tips of anterior 4–8 rays projecting from fin membrane, anteriormost rays about 50% free from membrane, succeeding rays less so; posteriormost ray attached membranously to dorsalmost caudal-fin ray for 1.8–5.3 (2.7)%. Anal fin with 33–38 (38) rays, posteriormost ray membranously attached to ventralmost caudal-fin ray for 2.6–5.3 (3.2)%. Two anal-fin pterygiophores and associated rays anterior to first haemal spine.

Pectoral-fin rays 33–39 (38) in two lobes separated by a shallow notch, 8–10 (9) rays in lower lobe. Pectoral-fin rays in notch slightly more widely spaced than rays of lobes. Dorsalmost ray at level of ventral rim of orbit. Upper lobe rounded, extending to anal-fin origin, length 15.7–19.7 (16.7)%, with ray 6 longest; length of shortest notch ray 5.3–9.5

(6.3)%; length of lower lobe 12.6–17.7 (15.2)%, extending between posterior margin of pelvic disk and anus, with ray 2 longest, rays 3–10 shortening ventrally.

Pelvic disk large, length 8.5–11.1 (9.8)%, width 7.9–10.7 (8.9)%. Distance from disk to anus 2.6–7.0 (5.8)%, about 25–70 (59.0)% disk length (DL), distance from anus to anal-fin origin 9.0–16.9 (11.7)%, about 80–175 (119.7)% DL. Urogenital papilla conical, short, when protruding about 11.5 (not protruding in holotype)% pelvic disk length, unpigmented. Pyloric caeca about 23 (holotype not dissected), on right side of body, finger-like, 25–50% HL.

Caudal fin slightly rounded, length 11.7–15.6 (13.9)%, depth at hypural plate 3.1–4.8 (4.2)%, with principal rays 11–13 (12), dorsal principal rays 5–6 (6), ventral principal rays 6–7 (6). Dorsal procurrent rays 1–3 (2), borne on epural and posteriormost neural spine; ventral procurrent ray one, borne on expanded posteriormost haemal spine. Vertebrae 46–49 (49), abdominal vertebrae 10–12 (11), caudal vertebrae 35–38 (38).

Body in life pink to red, with dark speckling at origin of dorsal fin; iris silver gray. Color in alcohol pale, with scattered speckling on nasal and other cephalic papillae and at dorsal-fin origin. Peritoneum black; orobranchial cavity pale.

Largest specimen examined a 173 mm female (UW 112287). Smallest female with yolked eggs 105 mm; smallest male with enlarged, swollen testes 74.5 mm.

Range

Allocareproctus jordani ranges from the type locality in Sagami Bay, Japan, through the Kuril Islands, eastern Sea of Okhotsk, off the southern tip of Kamchatka, the Aleutian Islands from Attu to Amukta I., and Pribilof Canyon, at depths of 75–631 m (Fig. 7).

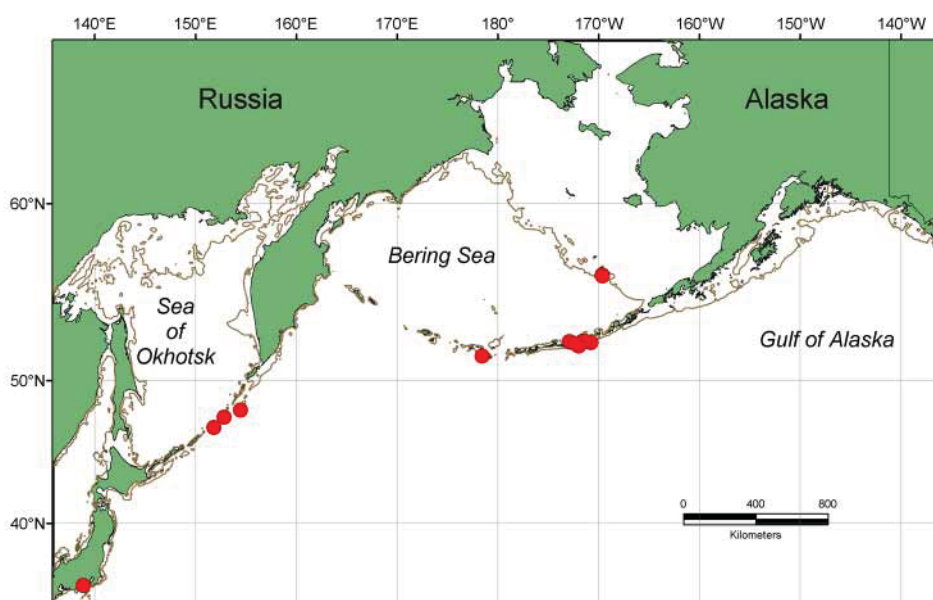


FIGURE 7. Distribution of *Allocareproctus jordani* based on material examined, 76 specimens in 23 lots. Each symbol may represent more than one capture.

Etymology

The specific epithet is a patronym honoring David Starr Jordan (Burke 1930).

Comparisons

Allocareproctus jordani is most similar to two new species described below: *A. unangas* and *A. ungak*. Both species differ from *A. jordani* in possessing strongly trilobed teeth. In addition, although counts of median-fin rays, pectoral-fin rays, vertebrae, and gill rakers overlap in total ranges, several characters differ significantly (Tables 1–3). Modes of all these characters differentiate *A. jordani* from *A. ungak*, *A. jordani* having significantly higher counts of median-fin rays, caudal vertebrae, and gill rakers, and lower counts of pectoral-fin rays. In contrast, anal-fin ray, pectoral-fin ray, and caudal vertebrae counts are significantly higher in *A. unangas*, while gill-raker counts are lower than in *A. jordani*.

The two other new species of *Allocareproctus* are readily distinguished from *A. jordani* by several characters. *Allocareproctus kallaion* differs externally in coloration, having a dark gray head, blotchy red body, and dark orobuccal cavity, unlike the uniform red and pale coloration of *A. jordani*. It also has a comb-like orobuccal valve (Fig. 12B), a higher count of larger gill rakers (Table 2), and a uniserial series of teeth in a comb-like row on the dentary. Counts of abdominal vertebrae are invariably 12 in *A. kallaion* versus typically 10–11 in *A. jordani* (3 of 55 specimens examined had 12 abdominal vertebrae; Table 2).

The pale peritoneum, fewer cephalic pores with papillae, and strongly trilobed teeth distinguish *A. tanix* from *A. jordani*. Several morphometric characters also differ significantly between *A. jordani* and *A. tanix*, including a greater body depth, head length, suborbital depth to both oral cleft and mandible, predorsal length, snout-to-pelvic disk length, and caudal length in *A. tanix*.

Remarks

Pitruk & Fedorov (1993) redescribed *A. jordani* on the basis of material collected from the Kuril Islands. We examined new material from the region (UW 112287 and UW 112284) and confirmed the identity of one of their specimens as *A. jordani* (ZIN 49891). Other components of their redescription of the species, including meristics, tooth shape, distribution of papillae, coloration, and overall body shape, agree with our characterization of *A. jordani* and exclude from their account the new species described below.

***Allocareproctus tanix* new species**

Peach Snailfish

(Figures 1–2, 4–6, 8, 13; Tables 1–4)

Careproctus pycnosoma: Kido 1985:14–16, figs. 3e, 8–9 (HUMZ 88509, Aleutian Island record); Mecklenburg *et al.* 2002 (after Kido 1985).

Holotype: UW 112294, 65.6 mm, 52.0938°N, 172.4286°W, 158 m depth, 4 June 2000, M/V *Dominator*, cruise 2000-01, haul 73, benthic bag, J.W. Orr.

Paratypes: UW 112295, 1(45.8 mm), 52.0038°N, 177.8278°E, 104 m depth, 11 July 2002, F/V *Sea Storm*, cruise 2002-01, haul 118, J.W. Orr; UW 113166, 1(63.8 mm, cleared and stained), 53.0785°N, 170.1512°W, 183 m depth, 14 June 2004, F/V *Gladiator*, cruise 2004-01, haul 31, benthic bag, K.P. Maslenikov; HUMZ 88509, 1(77.6 mm), 53.2545°N, 169.0573°W, 620 m depth, 19 July 1980, R/V *Hatsue Maru No. 62*, cruise 1980-01, haul 33.

Diagnosis

Teeth strongly trilobed (Fig. 2B); nasal papilla absent; other pore papillae reduced, invariably present only on maxillary pore 6; peritoneum pale; orobuccal valve with 1 finger-like projection; orobuccal cavity pale; gill rakers 9–10, short, blunt; interorbital papilla absent; pyloric caeca on left side, short; body peach to red; iris golden.

Description

Body relatively deep, depth at pectoral-fin base 17.8–23.0 (23.0)%, at center of pelvic disk 19.5–24.5 (24.5)%, at anal-fin origin 23.3–25.3 (25.3)%. Predorsal relatively long, length 29.0–34.5 (32.9)%. Preanal length 40.6–48.0 (46.8)%.

Head large, width 12.4–16.8 (16.8)%, length 26.3–29.7 (29.7)%. Interorbital width 5.5–6.4 (6.4)%, narrower than orbit length. Snout 7.7–9.2 (8.7)%. Mouth small, maxilla 10.8–12.0 (12.0)%, extending to anterior portion of orbit. Teeth strongly trilobed (Fig. 2B), in a band of 8–9 oblique rows of 9 teeth per row. Orbit large, length 6.4–7.1 (6.6)%.

Papillae present on few pores: absent from nasal pores; variably present on maxillary pores 5–6 (5–6); variably present on preoperculo-mandibular pores 5–7 (5–7); present on suprabranchial pores 1–2 (Fig. 4C). Papillae unpigmented. Interorbital papilla absent. Cephalic free neuromasts profuse, reduced or nearly indiscernible over interorbit and nape.

Gill opening small, 4.9–7.1 (6.1)%, entirely above pectoral fin or extending to pectoral-fin ray 3 (1). Gill rakers on anterior arch 9–10 (9), blunt and stout. Central projection of orobuccal valve a moderately elongate single lobe.

Dorsal-fin rays 41–42 (41), tips of anterior 4–6 rays projecting from fin membrane, anteriormost rays about 30% free from membrane, succeeding rays less so; posteriormost ray attached membranously to dorsalmost caudal-fin ray for 3.3–6.6 (5.6)%. Anal fin with 34–36 (36) rays, posteriormost ray membranously attached to ventralmost caudal-fin ray for 4.1–6.9 (6.9)%. One or two (2) anal-fin pterygiophores and associated rays anterior to first haemal spine.

Pectoral-fin rays 38–39 (39) in two lobes separated by shallow notch, 10 rays in lower lobe. Dorsalmost ray at level of ventral rim of orbit. Upper lobe rounded, extending to anal-fin origin, length 18.0–20.7 (20.7)%, with ray 8 longest; length of shortest notch ray

9.0–10.0 (9.6)%; length of lower lobe 16.6–19.9 (17.5)%, extending between posterior margin of pelvic disk to anus, with rays 2–3 (3) longest, rays 4–10 shortening ventrally.

Pelvic disk large, length 9.9–11.6 (10.7)%, width 9.0–11.1 (9.5)%. Distance from disk to anus 4.7–7.6 (4.7)%, about 45–75 (44.3)% DL, distance from anus to anal-fin origin 10.6–15.2 (15.2)%, about 103–143 (143)% DL. Urogenital papilla conical, short, 4.8–17.1 (17.1)% DL, unpigmented. Pyloric caeca 16–21 (16), on left side of body, finger-like, short, 14.4–27.8 (25.6)% HL.

Caudal fin slightly rounded, 14.6–17.4 (17.4)%, depth at hypural plate 3.7–5.2 (5.2)%, with principal rays 12–13 (12), dorsal principal rays 5 (5), ventral principal rays 7–8 (7). Dorsal procurrent rays 2–3 (2), borne on epural and posteriormost neural spine; ventral procurrent ray 1, borne on expanded posteriormost haemal spine. Vertebrae 45–47 (47), abdominal vertebrae 9–10 (10), caudal vertebrae 35–37 (37).

Body in life peach to red; iris golden. Color in alcohol pale, with pigment absent from cephalic papillae and at origin of dorsal fin. Peritoneum pale; orobranchial cavity pale.

Largest specimen examined a 77.6 mm female (HUMZ 88509). Smallest female with yolked eggs 77.6 mm; smallest male with enlarged, swollen testes 63.8 mm.

Range

Allocareproctus tanix has been found only in the eastern and central Aleutian Islands, from off Kiska, Seguam, and Umnak Islands, at depths of 104–620 m (Fig. 8).

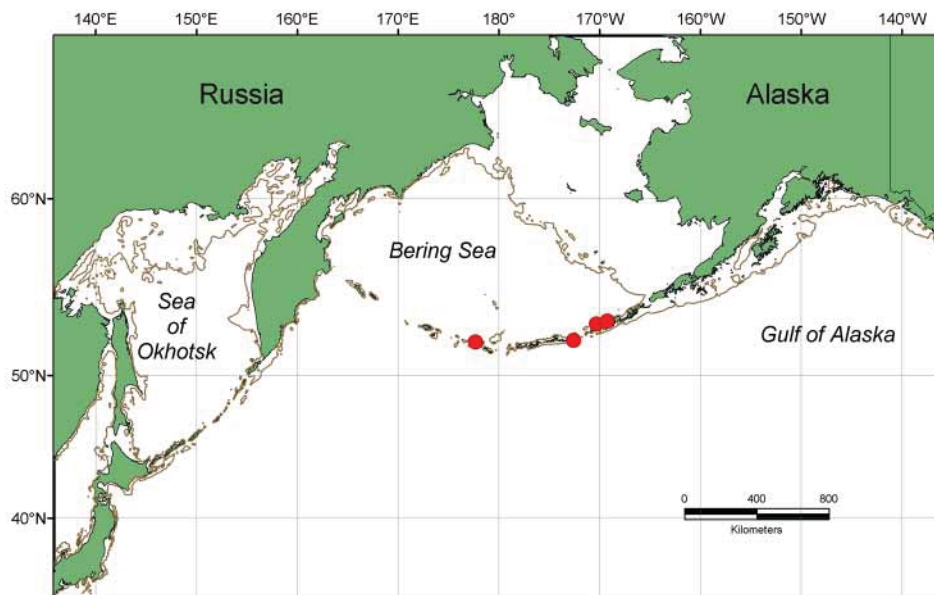


FIGURE 8. Distribution of *Allocareproctus tanix* based on all known material, four specimens in four lots.

Etymology

The specific epithet is derived from the Aleut word “tanix” for “forehead” in reference to the absence of nasal papillae on the pale head. It is to be treated as a noun in apposition.

Remarks

We collected three of the four specimens known and all were a distinctive peach coloration, unlike the red color of other species of *Allocareproctus*. Kido (1985) described the fourth specimen, which he identified as *C. pycnosoma*, as being red in life. This difference in coloration may be a reflection of the much greater depth at which his specimen was obtained (620 m, in contrast to the 104–183 m depth of our material).

Comparisons

Allocareproctus tanix can be distinguished from other species of *Allocareproctus* by its pale peritoneum, in contrast to the black peritoneum of all other species. It is further distinguished from *A. jordani* and *A. kallaion* by its strongly trilobed teeth and fewer cephalic pores with papillae, and from *A. unangas* by the absence of an interorbital papilla. Only *A. kallaion* can be distinguished from *A. tanix* using meristic characters; these characters include numbers of abdominal vertebrae and gill rakers (Table 2), which also distinguish *A. kallaion* from all other *Allocareproctus*. Several morphometric characters differ among *A. tanix* and other species of *Allocareproctus*, primarily a reflection of the deeper body of *A. tanix*. In *A. kallaion*, head length, body depth at anal-fin origin, upper and lower suborbital depth, predorsal length, snout to pelvic length, and pelvic disk length and width are less than in *A. tanix*. In *A. jordani*, the several morphometric characters discussed above are less than in *A. tanix*, and in *A. unangas*, suborbital depth to the mandible is less than in *A. tanix*.

Allocareproctus kallaion new species

Combed Snailfish

(Figures 1–6, 9, 12–13; Tables 1–4)

Holotype: UW 112244, 157.0 mm, female, 52.3405°N, 172.7455°W, 441 m depth, 31 May 2002, F/V *Morning Star*, cruise 2002-01, haul 32, J.W. Orr.

Paratypes: UW 112243, 3(145.0–190.0 mm), 52.3732°N, 171.3548°W, 324 m depth, 10 August 2002, F/V *Sea Storm*, cruise 2002-01, haul 225, R.C. Harrison; UW 112235, 1(162.0 mm), 52.3796°N, 170.6611°W, 278 m depth, 31 May 2000, F/V *Vesteraalen*, cruise 2000-01, haul 51, W.C. Flerx; UW 112241, 3(108.0–167.0 mm), 52.331°N, 172.7470°W, 441 m depth, 23 July 2002, F/V *Sea Storm*, cruise 2002-01, haul 156, J.W. Orr; UW 112237, 1(152.9 mm), 52.2383°N, 172.1247°W, 357 m depth, 29 July 2002, F/V *Sea Storm*, cruise 2002-01, haul 167, benthic bag, R.C. Harrison; UW 112236, 2(129.0–133.0 mm; 129.0 mm cleared and stained), 52.4877°N, 172.5677°W, 419 m

depth, 26 June 1997, M/V *Dominator*, cruise 1997-01, haul 71, R.C. Harrison; UW 112242, 3(139.5–176.0 mm), 52.3217°N, 172.7447°W, 458 m depth, 16 June 1994, F/V *Pacific Knight*, cruise 1994-01, haul 54; UW 112278, 8(109.8–157.0 mm), 52.3405°N, 172.7455°W, 441 m depth, 31 May 2002, F/V *Morning Star*, cruise 2002-01, haul 32, J.W. Orr; UW 112239, 1(161.0 mm), 52.3282°N, 172.7468°W, 444 m depth, F/V *Vesteraalen*, cruise 2000-01, haul 67, W.C. Flerx; UW 112238, 2(110.8–119.5 mm), 52.3282°N, 172.7468°W, 444 m depth, 4 June 2000, F/V *Vesteraalen*, cruise 2000-01, haul 67, benthic bag, W.C. Flerx; UW 113691, 16(72.0–170.0 mm), 52.3255°N, 172.7466°W, 450 m depth, 19 June 2004, F/V *Sea Storm*, cruise 2004-01, haul 60, J.W. Orr; USNM 385683, 2(113.0–165.0 mm), 52.3255°N, 172.7466°W, 450 m depth, 19 June 2004, F/V *Sea Storm*, cruise 2004-01, haul 60, benthic bag, J.W. Orr; USNM 385684, 1(156.0 mm), 52.4888°N, 172.5564°W, 397 m depth, 20 June 2004, F/V *Sea Storm*, cruise 2004-01, haul 61, J.W. Orr; CAS 223481, 1(146.0 mm), 52.5251°N, 172.0747°W, 364 m depth, 21 June 2004, F/V *Sea Storm*, cruise 2004-01, haul 66, J.W. Orr; CAS 223482, 1(195.0 mm), 52.2102°N, 172.2060°W, 341 m depth, 23 June 2004, F/V *Sea Storm*, cruise 2004-01, haul 73, J.W. Orr.

Diagnosis

Teeth simple (Fig. 2C); nasal pore 1 with pigmented papilla; peritoneum black; orobuccal valve with 4–6 finger-like projections; orobuccal cavity dark; gill rakers 14–18, stout, with strong spines at tip; interorbital papilla absent; body blotchy red, darker gray anteriorly; iris silver gray.

Description

Body depth at pectoral-fin base 11.8–18.6 (15.4)%, at center of pelvic disk 13.8–21.2 (18.0)%, at anal-fin origin 14.0–22.0 (18.8)%. Predorsal length 22.7–28.6 (25.2)%. Preanal length 38.8–47.0 (43.4)%.

Head large, width 12.4–19.6 (18.4)%, length 21.7–24.3 (22.4)%. Interorbital width 4.3–7.7 (5.1)%. Snout 5.5–8.8 (6.9)%. Mouth small, maxilla 7.5–11.3 (11.3)%, extending to anterior portion of orbit. Teeth simple, recurved, rarely with weak shoulders (Fig. 2C), in a narrow band of 4–12 oblique rows of 5–10 teeth per row in all except the posterior outer row; outer row of 34 teeth forming comb-like series. In all except outer row, middle teeth of each row largest; in outer row, first 20 teeth equally sized, succeeding teeth gradually smaller posteriorly. Orbit large, diameter 5.3–7.3 (6.1)%.

Papillae present on many pores: present on nasal pore 1, absent from nasal pore 2; present on maxillary pores 2–6, rarely present on pore 1 (2–6); present on preoperculomandibular pores 5–7, often present also on pore 4 (5–7); present on suprabranchial pores 1–2 (Fig. 4D). Papillae with slight pigment or unpigmented. Interorbital papilla absent. Cephalic free neuromasts large and profuse to nearly indiscernible over the interorbit and nape.

Gill opening small, 4.6–6.7 (5.6)%, entirely above pectoral fin. Gill rakers on anterior arch 14–18 (16), stout with strong spines at tip. Orobuccal valve with 4–6 (4) finger-like lobes, central lobe largest, other lobes successively smaller (Fig. 12B).

Dorsal-fin rays 42–45 (44), tips of anterior 4–6 rays projecting from fin membrane, anteriormost rays about 30% free from membrane, succeeding rays less so; posteriormost ray attached membranously to dorsalmost caudal-fin ray for 2.0–4.4 (2.7)%. Anal fin with 33–37 (36) rays, posteriormost ray membranously attached to ventralmost caudal-fin ray for 2.6–5.1 (3.4)%. One to three (2) anal-fin pterygiophores and associated rays anterior to first haemal spine.

Pectoral-fin rays 36–40 (37) in two lobes separated by shallow notch, 9–12 (10) rays in lower lobe. Dorsalmost ray at level just below ventral rim of orbit. Upper lobe rounded, extending to anal-fin origin, length 15.8–20.1 (17.6)%, with rays 6–7 (6) longest; length of shortest notch ray 4.3–9.5 (6.7)%; length of lower lobe 13.3–20.2 (15.0)%, extending between posterior margin of pelvic disk and anus, with ray 3 longest, rays 9–12 shortening ventrally.

Pelvic disk large, length 8.0–9.7 (8.5)%, width 7.1–8.8 (7.8)%. Distance from disk to anus 2.7–9.4 (6.2)%, about 28–105 (73.7)% DL, distance from anus to anal-fin origin 11.6–18.9 (16.6)%, about 125–225 (196)% DL. Urogenital papilla conical, short, about 10–25 (11.2)% DL when protruded, unpigmented. Pyloric caeca about 22–27 (22), on right side of body, finger-like, long, 25–50 (48.4)% HL.

Caudal fin slightly rounded, 12.8–17.1 (14.3)%, depth at hypural plate 2.7–4.6 (2.9)%, with principal rays 11–14 (12), dorsal principal rays 5–7 (5), ventral principal rays 6–7 (7). Dorsal procurrent rays 2–3 (2), borne on epural and posteriormost neural spine; ventral procurrent ray 1–2 (1), borne on expanded posteriormost haemal spine. Vertebrae 45–49 (49), abdominal vertebrae 12, caudal vertebrae 33–37 (37).

Color in life light red, with darker red blotches scattered over body, dark speckling at origin of dorsal fin, anterior part of body blue-gray, posterior part of body blotchy red; iris silver gray. Color in alcohol dark gray anteriorly, becoming pale posteriorly, with pigment on cephalic papillae and at origin of dorsal fin. Peritoneum black; orobranchial cavity dark.

Largest specimen examined a 195 mm male (CAS 223482). Smallest female with yolked eggs 162 mm; smallest male with enlarged, swollen testes 124 mm.

Range

Allocareproctus kallaion has been collected only in the east-central Aleutian Islands, from Seguam Pass to Yunaska Island at depths of 278–458 m (Fig. 9).

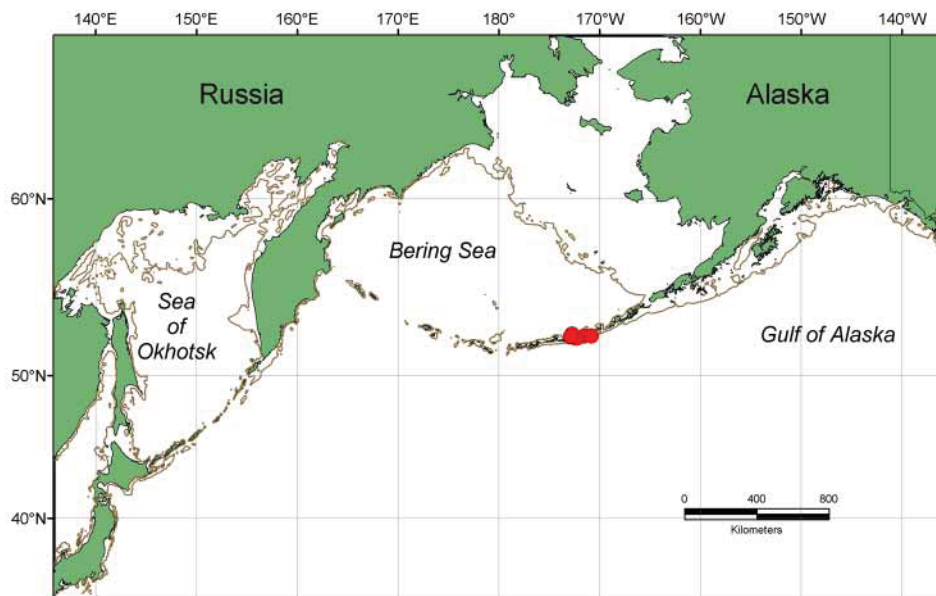


FIGURE 9. Distribution of *Allocareproctus kallaion* based on all known material, 48 specimens in 15 lots.

Etymology

The specific epithet is derived from the Greek “καλλαιον” for “comb”, an allusion to the multiple projections on the orobuccal valve and the single row of teeth on the posterior part of the dentary.

Remarks

Unlike other species of *Allocareproctus*, larger specimens of *A. kallaion* were often collected with greatly distended stomachs filled with water. This mechanism of inflation in *A. kallaion* is similar to that of puffer fishes (Tetraodontiformes; Brainerd 1994, Wainwright & Turingan 1997) and frogfishes (Antennariidae; Pietsch & Grobecker 1987). Members of the putative sister family of the Liparidae, the Cyclopteridae, are well known for their ability to expand when disturbed, although the mechanism of inflation has not been examined (Mecklenburg *et al.* 2002).

Comparisons

Allocareproctus kallaion is easily distinguished from all other species of *Allocareproctus* by the following characters. Its body in life is a blotchy red unlike the uniform red to peach coloration of other species. Both in life and when preserved, the anterior part of the body and orobuccal cavity are darker, unlike the pale color of other species. It differs from all other species in having multiple lobes on the orobuccal valve (Fig. 12B), high numbers (14–18 vs. 7–12 in all other species) of larger gill rakers with

stronger spines on the tips, invariably 12 abdominal vertebrae, and a comb-like uniserial row of teeth on the dentary. Its simple teeth further distinguish it from *A. tanix*, *A. unangas*, and *A. ungak*, which all possess moderately to strongly trilobed teeth (Fig. 2).

Several morphometric characters differ significantly between *A. kallaion* and all other species of *Allocareproctus*. Head length, body depth, snout length, suborbital depths to oral cleft and mandible, predorsal length, snout to anus length, pelvic-disk length and width, and lengths of dorsal- and anal-fin connections to the caudal fin are less, while pelvic disk to anus length is greater than in all other species.

***Allocareproctus unangas* new species**

Goldeneye Snailfish

(Figures 1–2, 6, 10, 13; Tables 1–4)

Holotype: UW 112308, 82.5 mm, 53.1274°N, 169.9643°W, 387 m depth, 1 June 2002, F/V *Morning Star*, cruise 2002-01, haul 35, J.W. Orr/D.E. Stevenson.

Paratypes: UW 112300, 1(129.7 mm), female, 53.2067°N, 169.8452°W, 399 m depth, 4 June 2002, F/V *Morning Star*, cruise 2002-01, haul 52, J.W. Orr; UW 112313, 1(115.2 mm), 53.0363°N, 170.2986°W, 210 m depth, 27 May 2000, F/V *Vesteraalen*, cruise 2000-01, haul 39, W.C. Flerx; UW 112303, 2(79–105.8 mm), 51.5636°N, 178.3331°E, 465 m depth, 30 June 2000, M/V *Dominator*, cruise 2000-01, haul 159, K.P. Maslenikov; UW 112306, 2(40.3–64.4 mm), 53.1899°N, 169.8622°W, 398 m depth, 19 July 2002, F/V *Vesteraalen*, cruise 2002-01, haul 195, R.N. Clark; UW 112305, 1(104.2 mm), 52.2762°N, 170.5968°W, 231 m depth, 30 May 2000, M/V *Dominator*, cruise 2000-01, haul 49, J.W. Orr; UW 112304, 1(126.2 mm), 52.40236°N, 171.8333°W, 270 m depth, 8 August 2002, F/V *Sea Storm*, cruise 2002-01, haul 213, R.C. Harrison; UW 112087, 1(83 mm), 53.1303°N, 169.9617°W, 433 m depth, 26 May 2000, F/V *Vesteraalen*, cruise 2000-01, haul 35, W.C. Flerx; UW 112089, 2(73.5–78.6 mm), 52.4212°N, 170.2785°W, 211 m depth, 29 May 2000, M/V *Dominator*, cruise 2000-01, haul 43, benthic bag, J.W. Orr; UW 112301, 1(117.7 mm), 52.3896°N, 171.36°W, 234 m depth, 11 June 2000, M/V *Dominator*, cruise 2000-01, haul 82, K.P. Maslenikov; UW 112302, 2(76.7–98.2 mm), 52.3675°N, 171.3377°W, 318 m depth, 11 June 2000, M/V *Dominator*, cruise 2000-01, haul 83, benthic bag, K.P. Maslenikov; UW 112085, 1(78 mm), 51.9056°N, 176.6003°E, 264 m depth, 5 July 2000, F/V *Vesteraalen*, cruise 2000-01, haul 173, E.S. Brown; UW 112086, 1(101.6 mm), 52.3679°N, 171.2465°W, 316 m depth, 18 June 1997, F/V *Vesteraalen*, cruise 1997-01, haul 42, W.C. Flerx; UW 112088, 2(84.2–102 mm; 84.2 mm cleared and stained), 52.5303°N, 172.1104°W, 364 m depth, 26 June 1997, F/V *Vesteraalen*, cruise 1997-01, haul 78, R.C. Harrison; UW 112307, 1(101.7 mm), 52.2383°N, 172.1247°W, 357 m depth, 29 July 2002, F/V *Sea Storm*, cruise 2002-01, haul 167, R.C. Harrison; USNM 385685, 4(68.3–96.1 mm), 52.3687°N, 171.2406°W, 323 m depth, 5 May 2000, M/V *Dominator*, cruise 2000-01, haul 51, benthic bag, J.W. Orr; USNM 385686, 1(118 mm),

52.5080°N, 172.2650°W, 215 m depth, 21 June 2004, F/V *Sea Storm*, cruise 2004-01, haul 65, J.W. Orr; USNM 385687, 2(95–115 mm), 52.9580°N, 169.4346°W, 429 m depth, 12 June 2004, F/V *Gladiator*, cruise 2004-01, haul 26, K.P. Maslenikov; CAS 223483, 1(92 mm), 52.8965°N, 169.4597°W, 341 m depth, 13 June 2004, F/V *Gladiator*, cruise 2004-01, haul 29, benthic bag, K.P. Maslenikov; CAS 223484, 1(113 mm), 53.2200°N, 169.7387°W, 323 m depth, 13 June 2004, F/V *Gladiator*, cruise 2004-01, haul 27, K.P. Maslenikov; CAS 223485, 1(105 mm), 53.0341°N, 170.2061°W, 176 m depth, 14 June 2004, F/V *Gladiator*, cruise 2004-01, haul 32, benthic bag, K.P. Maslenikov; UW 28351, 2(82.2–128.7 mm), no data.

Diagnosis

Teeth strongly trilobed (Fig. 2D); nasal papillae absent; papillae associated with few pores, invariably present only on maxillary pore 6 and suprabranchial pores 1–2; peritoneum dark; orobuccal valve with 1 finger-like projection; orobuccal cavity pale; gill rakers 8–12, short, blunt; interorbital papilla present; pyloric caeca on left side, short; body color light red; iris golden.

Description

Body depth at pectoral-fin base 14.2–22.6 (20.1)%, at center of pelvic disk 18.9–24.6 (20.4)%, at anal-fin origin 18.8–26.5 (25.5)%. Predorsal length 26.5–33.3 (29.7)%. Preanal length 37.4–46.4 (41.9)%.

Head large, width 12.7–18.8 (15.3)%, length 25.1–28.2 (25.7)%. Interorbital width 5.1–8.2 (5.1)%, about equal to orbit length. Snout 6.5–9.2 (8.8)%. Mouth small, maxilla 8.4–12.0 (11.1)%, extending to anterior portion of orbit. Teeth strongly trilobed (Fig. 2D), in a band of 8–12 oblique rows of 5–9 teeth per row. Orbit large, diameter 5.0–7.8 (5.0)%.

Papillae small, present on few pores: absent from nasal pores 1–2; present on maxillary pore 6, often present on pore 5 (5–6); often present on preoperculo-mandibular pores 6–7, rarely absent (6–7); present on suprabranchial pores 1–2 (Fig. 4E). Interorbital papilla present. Papillae unpigmented. Cephalic free neuromasts reduced or nearly indiscernible over the interorbit and nape.

Gill opening small, 4.7–7.1 (5.9)%, entirely above pectoral fin or extending to pectoral-fin ray 3 (entirely above in the holotype). Gill rakers on anterior arch 8–12 (9), blunt and stout. Central projection of orobuccal valve a moderately elongate single lobe.

Dorsal-fin rays 42–45 (44), tips of anterior 4–6 rays projecting from fin membrane, anteriormost rays about 30% free from membrane, succeeding rays less so; posteriormost ray attached membranously to dorsalmost caudal-fin ray for 2.5–5.0 (3.6)%. Anal fin with 36–39 (38) rays, posteriormost ray membranously attached to ventralmost caudal-fin ray for 3.0–5.3 (3.6)%. One to three (2) anal-fin pterygiophores and associated rays anterior to first haemal spine.

Pectoral-fin rays 38–42 (39) in two lobes separated by shallow notch, 9–10 (10) rays

in lower lobe. Dorsalmost ray at level of ventral rim of orbit. Upper lobe rounded, extending to or just past anal-fin origin, length 15.4–20.1 (17.0)%, with ray 6 longest; length of shortest notch ray 4.9–10.9 (10.9)%; length of lower lobe 13.4–19.5 (15.7)%, extending to anus, with ray 2 longest, rays 3–10 shortening ventrally. Pelvic disk large, length 7.8–11.4 (10.3)%, width 7.4–10.7 (9.9)%. Distance from disk to anus 1.7–8.3 (5.6)%, about 20–90 (54.5)% DL, distance from anus to anal-fin origin 5.7–15.8 (13.5)%, about 50–150 (130.6)% DL. Urogenital papilla conical, short, 9.2–30.5 (30.5)% DL, unpigmented. Pyloric caeca about 22, on left side of body, fingerlike, short, 17.2–28.5 (24.0)% HL.

Caudal fin slightly rounded, 11.7–17.0 (13.5)%, depth at hypural plate 2.4–5.2 (3.4)%, with principal rays 11–12 (12), dorsal principal rays 5, ventral principal rays 6–7 (7). Dorsal procurent rays 1–3 (2), borne on epural and posteriormost neural spine; ventral procurent ray 1–2 (1), borne on expanded posteriormost haemal spine. Vertebrae 46–50 (48), abdominal vertebrae 10–11 (10), caudal vertebrae 36–40 (38).

Body color in life uniform light red; iris golden. Color in alcohol pale, with pigment absent from cephalic papillae and absent from origin of dorsal fin. Peritoneum black; orobranchial cavity pale.

Largest specimen examined a 129.7 mm female (UW 112300). Smallest female with yolked eggs 91 mm; smallest male with enlarged, swollen testes 76.7 mm.

Range

Allocareproctus unangas has been collected only in the Aleutian Islands, from Buldir Pass to the Islands of Four Mountains, at depths of 210 to 465 m (Fig. 10).

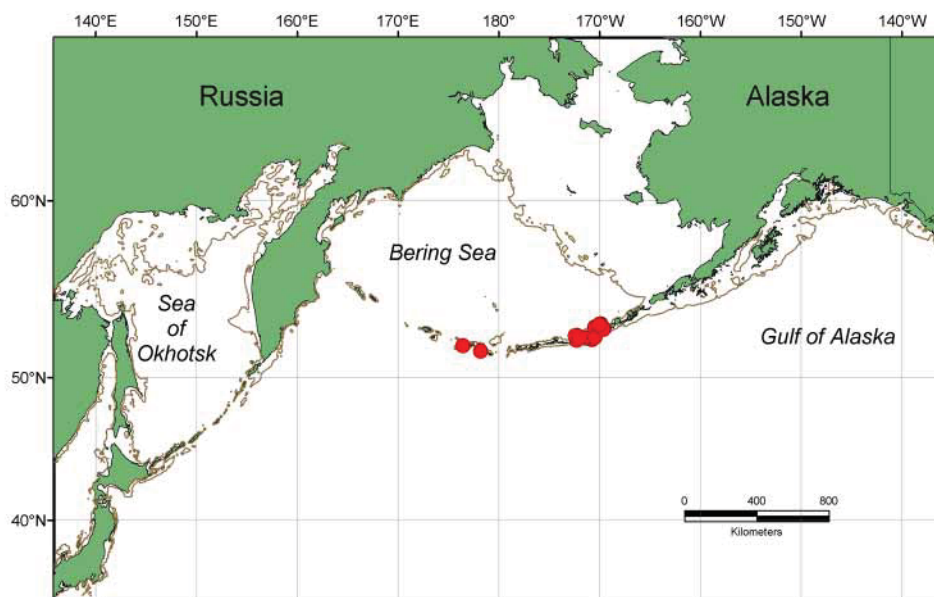


FIGURE 10. Distribution of *Allocareproctus unangas* based on all known material, 36 specimens in 22 lots.

Etymology

Named in honor of the people of the Aleutian Islands, the specific epithet “unangas” is the autonym of the Aleuts of Atka Island, a major island near the center of the species distribution. It is to be treated as a noun in apposition.

Remarks

Eggs of *A. unangas* were collected from the octocoral *Primnoa* sp. from Seguam Pass, with eggs of another liparid (Busby *et al.*, in press). These are the first records of spawning in nature outside of lithodid crabs for liparids other than species of *Liparis*. See description and discussion of Busby *et al.* (in press).

Comparisons

Allocareproctus unangas is most similar to *A. ungak*, which also has trilobed teeth (Fig. 2D–E) and a uniform red body. It is distinguished from *A. ungak* by its golden iris (vs. silver gray in *A. ungak*), papilla on nasal pore 1, fewer pores with associated papillae (Fig. 4), and pyloric caeca shorter and on the left side of the body. The two species also exhibit significant modal differences in several meristic characters (Tables 1–3), including dorsal-fin rays (39–42 in *A. ungak* vs. 42–45 in *A. unangas*), anal-fin rays (33–35 vs. 36–39), pectoral-fin rays (35–40 vs. 38–42), and caudal vertebrae (34–36 vs. 36–40). Morphometric differences include a greater head length, body depths at anal-fin origin and pelvic disk, predorsal length, and snout to anus length in *A. unangas* than in *A. ungak*. See other comparisons under species accounts above.

***Allocareproctus ungak* new species**

Whiskered Snailfish

(Figures 1–2, 4–6, 11, 13; Tables 1–4)

Allocareproctus jordani: Orr & Busby 2001 (in part; compared to *Prognatholiparis ptychomandibularis*).

Holotype: UW 111933, 91.0 mm, female, 52.3687°N, 171.2406°W, 323 m depth, 31 May 2000, M/V *Dominator*, cruise 2000-01, haul 51, benthic bag, J.W. Orr.

Paratypes: UW 112084, 4(55.0–106.9 mm), 52.3282°N, 172.7468°W, 444 m depth, 4 June 2000, F/V *Vesteraalen*, cruise 2000-01, haul 67, benthic bag, W.C. Flerx; UW 111934, 1(106 mm), 52.3282°N, 172.7468°W, 444 m depth, 4 June 2000, F/V *Vesteraalen*, cruise 2000-01, haul 67, W.C. Flerx; UW 111935, 2(97.3–98.4 mm), 52.3131°N, 171.5057°W, 445 m depth, 31 May 2000, M/V *Dominator*, cruise 2000-01, haul 54, benthic bag, J.W. Orr; UW 111929, 1(105.5 mm), 52.1920°N, 171.6730°W, 461 m depth, 6 August 2002, F/V *Sea Storm*, cruise 2002-01, haul 210, R.C. Harrison; UW 45239, 17(81.5–101.2 mm; 84.5 mm cleared and stained), 52.3184°N, 172.7453°W, 455 m depth, 22 June 1997, F/V *Vesteraalen*, cruise 1997-01, haul 58, W.C. Flerx; UW 111937, 1(87

mm), 52.5517°N, 169.4788°W, 330 m depth, 25 May 2003, F/V Northwest Explorer, cruise 2003-01, haul 6, J.W. Orr; UW 111933, 1(91 mm, in 95% ethanol), 52.3687°N, 171.2406°W, 323 m depth, 31 May 2000, M/V *Dominator*, cruise 2000-01, haul 51, J.W. Orr; UW 111938, 1(112 mm), 52.3687°N, 171.2406°W, 323 m depth, 31 May 2000, M/V *Dominator*, cruise 2000-01, haul 51, J.W. Orr; UW 45238, 3(72.1–91.7 mm), 52.3310°N, 172.7470°W, 441 m depth, 23 July 2002, F/V *Sea Storm*, cruise 2002-01, haul 156, J.W. Orr; UW 111928, 2(85.8–93.2 mm), 52.3687°N, 171.2406°W, 323 m depth, 31 May 2000, M/V *Dominator*, cruise 2000-01, haul 51, benthic bag, J.W. Orr; UW 111927, 1(94.3 mm), 52.3732°N, 171.3548°W, 324 m depth, 10 August 2002, F/V *Sea Storm*, cruise 2002-01, haul 225, R.C. Harrison; USNM 385688, 3(97–115 mm), 52.5251°N, 172.0747°W, 364 m depth, 21 June 2004, F/V *Sea Storm*, cruise 2004-01, haul 66, J.W. Orr; USNM 385689, 3(62–78 mm), 52.3255°N, 172.7466°W, 450 m depth, 19 June 2004, F/V *Sea Storm*, cruise 2004-01, haul 60, benthic bag, J.W. Orr; CAS 223486, 7(91–107 mm), 52.3728°N, 171.3587°W, 318 m depth, 21 June 2004, F/V *Gladiator*, cruise 2004-01, haul 65, K.P. Maslenikov; UW 113675, 1(94.5 mm), 52.1932°N, 171.6718°W, 461 m depth, 20 June 2004, F/V *Gladiator*, cruise 2004-01, haul 58, K.P. Maslenikov; UW 113676, 1(129.3 mm), 52.9580°N, 169.4346°W, 429 m depth, 12 June 2004, F/V *Gladiator*, cruise 2004-01, haul 26, K.P. Maslenikov.

Diagnosis

Teeth strongly trilobed (Fig. 2E); nasal pore 1 with unpigmented papilla; peritoneum black; orobuccal valve with 1 finger-like projection; orobuccal cavity pale; gill rakers 7–11, short, blunt; interorbital papilla present or absent; pyloric caeca on right or left side; body red; iris silver gray.

Description

Body depth at pectoral-fin base 15.0–21.0 (19.5)%, at center of pelvic disk 16.6–22.9 (21.9)%, at anal-fin origin 18.2–25.2 (22.0)%. Predorsal length 25.9–29.7 (27.3)%. Preanal length 38.4–47.3 (43.1)%. Head large, width 11.8–20.4 (14.1)%, length 23.9–27.3 (24.7)%. Interorbital width 4.9–8.0 (5.7)%, about equal to orbit length. Snout 6.8–9.3 (7.9)%. Mouth small, maxilla 9.0–12.1 (10.1)%, extending to midorbit. Teeth strongly trilobed (Fig. 2E), in a broad band of 8–12 oblique rows of 5–16 teeth per row, band narrowing posteriorly to 2–3 rows on premaxilla and to a short uniserial row of 6 teeth on dentary. Orbit large, diameter 5.2–7.0 (6.2)%.

Papillae strong, present on many pores: present on nasal pore 1, absent from nasal pore 2; present on maxillary pores 4–6, often present on pores 2–3 (4–6); present on preoperculo-mandibular pores 5–6, often present also on pore 7 (5–7); present on suprabranchial pores 1–2 (Fig. 4F). Interorbital papilla present or absent (present in holotype). Papillae unpigmented. Cephalic free neuromasts reduced and nearly indiscernible over the interorbit and nape.

Gill opening small, 4.9–7.8 (7.6)%, entirely above pectoral fin or extending to pectoral-fin ray 3 (1). Gill rakers on anterior arch 7–11 (10), short and blunt. Central projection of orobuccal valve a moderately elongate single lobe.

Dorsal-fin rays 39–42 (41), tips of anterior 4–6 rays projecting from fin membrane, anteriormost rays about 30% free from membrane, succeeding rays less so; posteriormost ray attached membranously to dorsalmost caudal-fin ray for 2.3–5.8 (4.0)%. Anal fin with 33–35 (34) rays, posteriormost ray membranously attached to ventralmost caudal-fin ray for 3.0–5.9 (3.6)%. One or two (2) anal-fin pterygiophores and associated rays anterior to first haemal spine.

Pectoral-fin rays 35–40 (37) in two lobes, separated by shallow notch, 8–10 (9) rays in lower lobe. Dorsalmost ray at level of ventral rim of orbit. Upper lobe rounded, extending to anal-fin origin, length 16.0–20.0 (17.1)%, with rays 5–6 (5) longest; length of shortest notch ray 5.8–10.5 (6.0)%; length of lower lobe 14.4–19.8 (15.9)%, extending between posterior margin of pelvic disk and anus, with ray 3 longest, rays 4–10 shortening ventrally.

Pelvic disk large, length 8.6–11.8 (8.8)%, width 7.1–11.1 (8.2)%. Distance from disk to anus 1.5–5.5 (4.8)%, about 13–55 (55)% DL, distance from anus to anal-fin origin 6.7–18.8 (13.4)%, about 50–200 (152.5)% DL. Urogenital papilla conical, relatively long, 4–96.5 (6.0)% DL, unpigmented. Pyloric caeca about 20, primarily on right side of body, finger-like, long, about 25–50 (40)% HL.

Caudal fin slightly rounded, 13.0–17.1 (14.4)%, depth at hypural plate 3.3–5.2 (4.2)%, with principal rays 11–13 (12), dorsal principal rays 5–6 (5); ventral principal rays 7–8 (7). Dorsal procurrent rays 2, borne on epural and posteriormost neural spine; ventral procurrent ray 1, borne on expanded posteriormost haemal spine. Vertebrae 45–47 (46), abdominal vertebrae 10–11 (11), caudal vertebrae 34–36 (35).

Body in life uniform light red, scattered speckling rarely present at origin of dorsal fin; iris silver gray. Color in alcohol pale, with pigment absent from cephalic papillae and rarely present at origin of dorsal fin. Peritoneum black; orobranchial cavity pale.

Largest specimen examined a 129.3 mm male (UW 113676). Smallest female with yolked eggs 85 mm; smallest male with enlarged, swollen testes 95 mm.

Range

Allocareproctus ungak has been collected only in the Aleutian Islands, from Seguam Pass to the Islands of Four Mountains, at depths of 318 to 461 m (Fig. 11).

Etymology

The specific epithet “ungak” is taken from the Alutiiq word for “whiskers” an allusion to the many papillae associated with cephalic pores. It is to be treated as a noun in apposition.

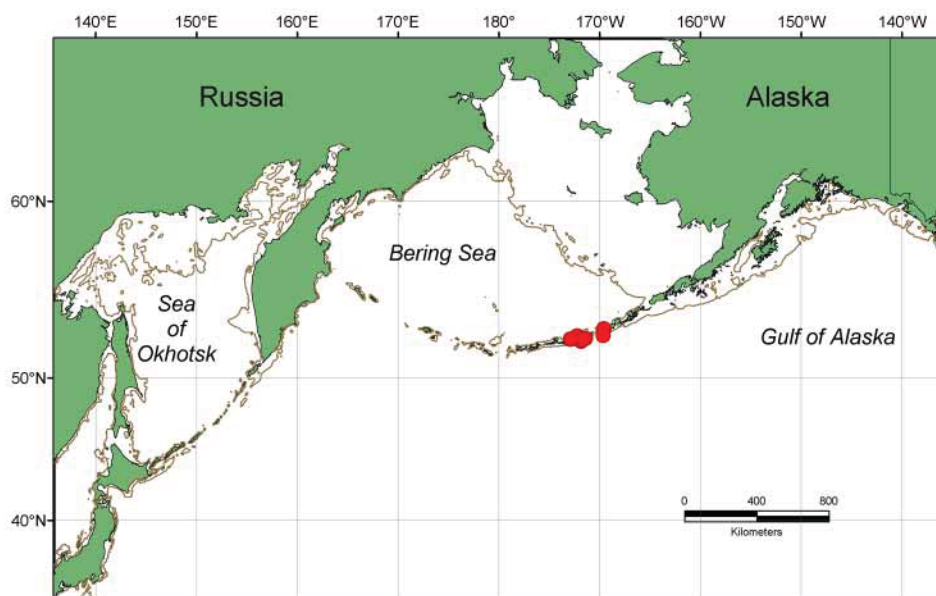


FIGURE 11. Distribution of *Allocareproctus ungak* based on all known material, 50 specimens in 14 lots.

Comparisons

Allocareproctus ungak is most similar to *A. unangas*, which also has trilobed teeth (Fig. 2D–E) and a uniform red body. It is distinguished from *A. unangas* by the presence of a papilla on nasal pore 1 and higher number of pores with associated papillae (Fig. 4). Pyloric caeca are longer and typically on the right side of the body, unlike *A. unangas* in which they are shorter and on the left. For meristic and morphometric differences from other species of *Allocareproctus*, see species accounts above.

Statistical analyses

Univariate analyses

Several significant differences were found among species using ANOVA for meristic characters and ANCOVA for morphometric characters (Table 3). Dorsal-, anal-, and pectoral-fin ray, caudal vertebrae, and gill raker counts were all significantly different among species tested. Except for a significant difference in numbers of gill rakers with *A. kallaion*, which also differed from all species, *A. tanix* did not differ significantly from other species in any other meristic character. Head length, body depth at anal-fin origin, orbit length, predorsal length, pelvic disk to anus length, and the distance of connections of anal-fin and dorsal-fin membranes to the caudal fin differed significantly. *Allocareproctus tanix* also differed from *A. kallaion* in all these characters, as well as in some characters

that were nonsignificant in comparison with other species, including suborbital depth to oral cleft and mandible, snout and mandible to pelvic disk length, and pelvic-disk length and width. In addition, suborbital depth to mandible was significantly different between *A. tanix* and *A. unangas*.

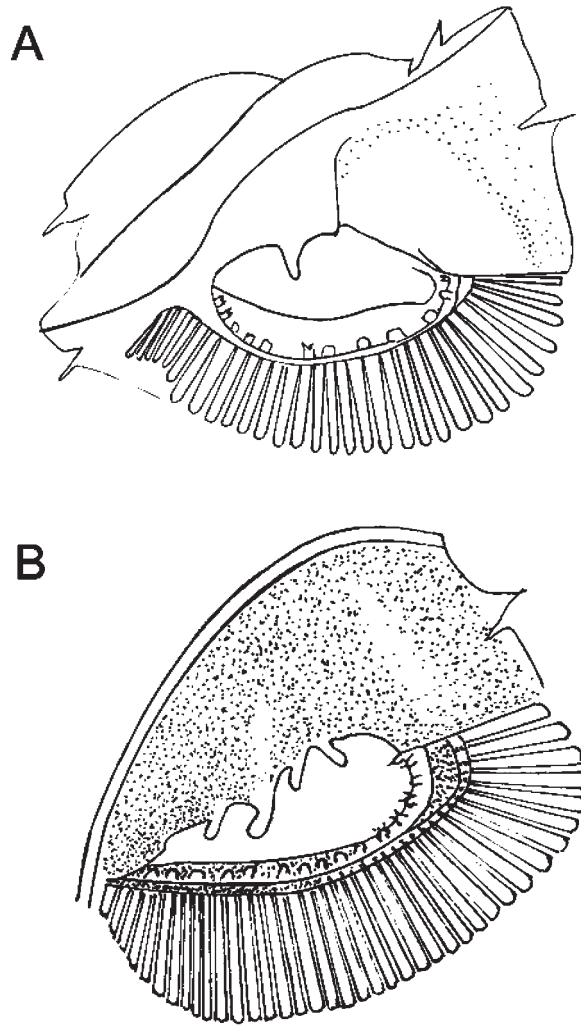


FIGURE 12. Orobuccal valve of A) *Allocareproctus jordani* and B) *Allocareproctus kallaion*. Anterior to left, operculum lifted out and dorsally. Illustrations by B.M. Vinter.

Principal component analysis

In the meristic PCA of all species (Fig. 13), all individuals formed narrowly overlapping species clusters. Principal component 1 accounted for 38.8% of the variance, with anal-fin rays, dorsal-fin rays, and caudal vertebrae loading most heavily (Table 4), widely separating *A. unangas* from *A. ungak*, while other species were intermediate. Accounting for 33.0% of the variance, PC2 was most heavily loaded with abdominal

vertebrae, dorsal-fin rays, and gill rakers (Table 4), separating *A. kallaion* from all other species and providing some separation of most individuals of *A. jordani* from other species.

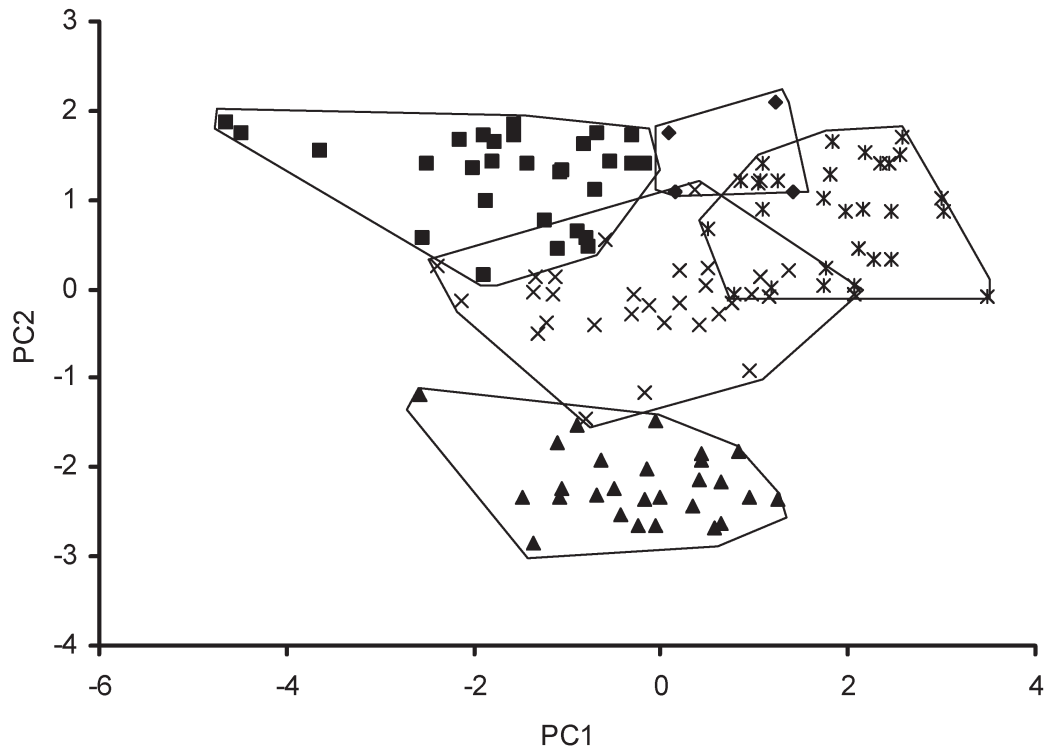


FIGURE 13. Plots of principal component scores for meristic characters of species of *Allocareproctus*: *Allocareproctus jordani* (×), *A. tanix* (◆), *A. kallaion* (▲), *A. unangas* (■), *A. ungak* (◇).

TABLE 4. Factor loadings for principal components (PC) analysis of meristic characters of species of *Allocareproctus*: *A. kallaion*, *A. jordani*, *A. ungak*, *A. unangas*, and *A. tanix*.

| | PC1 | PC2 | PC3 |
|---------------------------|---------|---------|---------|
| Dorsal-fin rays | -0.5432 | -0.2768 | -0.1451 |
| Anal-fin rays | -0.5881 | 0.1174 | -0.1429 |
| Pectoral-fin rays | -0.2960 | 0.1916 | 0.9040 |
| Abdominal vertebrae | -0.0186 | -0.6737 | -0.0318 |
| Caudal vertebrae | -0.5145 | 0.1692 | -0.2461 |
| Gill rakers on first arch | -0.0799 | -0.6249 | 0.2823 |

Acknowledgments

We were generously advised by M. Dirks (Unalaska City School District) and J. Sepez (AFSC) on the selection of Aleut and Alutiiq names for *A. unangas*, *A. tanix*, and *A. ungak*. We thank the collectors of our new material, including K.P. Maslenikov (UW), W.C. Flerx, R.C. Harrison, G.R. Hoff, D.W. Kessler, R.R. Lauth, M.M. Martin, J.W. Stark, D.E. Stevenson (all of AFSC) and R.N. Clark (contracted to AFSC) for eastern Pacific material, and A.M. Orlov (Russian Federal Research Institute of Fisheries and Oceanography) for western Pacific specimens. K.P. Maslenikov and T.W. Pietsch (UW) cataloged and curated material from collections in Alaskan waters and provided access to collections. K. Nakaya and M. Yabe (HUMZ) and A.V. Balushkin and N.V. Chernova (ZIN) provided loans and access to collections. M.A. Rogers (FMNH) provided radiographs, photographs, and descriptions of type material and with M.W. Westneat (FMNH) hosted our visit to the Field Museum of Natural History. J.T. Williams and S. Raredon (USNM) provided loans, photographs, and radiographs of type material and hosted our visit to the U.S. National Museum of Natural History. We thank B.M. Vinter (AFSC) for providing several illustrations. A.C. Matarese (AFSC), D.E. Stevenson, K.P. Maslenikov, T.W. Pietsch, and W.L. Smith (AMNH) critically reviewed the manuscript.

References

- Andriashev, A. P. & Stein, D. L. (1998) Review of the snailfish genus *Careproctus* (Liparidae, Scorpaeniformes) in Antarctic and adjacent waters. *Contributions in Science, Natural History Museum of Los Angeles County*, 470, 1–63.
- Brainerd, E.L. (1994) Pufferfish inflation: functional morphology of postcranial structures in *Diodon holocanthus* (Tetraodontiformes). *Journal of Morphology*, 220, 243–262.
- Burke, C.V. (1912) A new genus and six new species of fishes of the family Cyclogasteridae. *Proceedings of the United States National Museum*, 43(1941), 567–574.
- Burke, C.V. (1930) Revision of the fishes of the family Liparidae. *Bulletin of the United States National Museum*, 150, 1–204.
- Busby, M.S., Orr, J.W. & Blood, D.M. (In press) Description of eggs and late stage embryos of *Allocareproctus unangas* Orr and Busby (family Liparidae) from the Aleutian Islands. *Ichthyological Research*.
- Chernova, N.V., Stein, D.L. & Andriashev, A.P. (2004) Family Liparidae Scopoli 1777—snailfishes. *California Academy of Sciences, Annotated Checklists of Fishes*, 31, 1–72.
- Cohen, D. (1968) The cyclopterid genus *Paraliparis*, a senior synonym of *Gymnolycodes* and *Eutelichthys*, with the description of a new species from the Gulf of Mexico. *Copeia*, 1968(2), 384–388.
- Gilbert, C.H. & Burke, C.V. (1912) Fishes from Bering Sea and Kamchatka. *Bulletin of the United States Bureau of Fisheries*, 30(1910), 31–96.
- Jordan, D.S. & Thompson, W.F. (1914) Record of the fishes obtained in Japan in 1911. *Memoirs of the Carnegie Museum*, 6(4), 205–313.
- Kido, K. (1984) Liparidae. In: Masuda, H., Amaoka, K., Araga, C., Uyeno, Y., Yoshimo, T. (ed.) *The fishes of the Japanese Archipelago*. Tokai University Press, Tokyo, pp. 337–341.

- Kido, K. (1985) New and rare species of the genus *Careproctus* (Liparididae) from the Bering Sea. *Japanese Journal of Ichthyology*, 32(1), 6–17.
- Kido, K. (1988) Phylogeny of the family Liparididae, with the taxonomy of the species found around Japan. *Memoirs of the Faculty of Fisheries, Hokkaido University*, 35(2), 1–125.
- Leviton, A.E., Gibbs, R.H., Jr., Heal, E. & Dawson, C. E. (1985) Standards in herpetology and ichthyology: part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. *Copeia*, 1985(4), 802–832.
- Matsubara, K. (1955) *Fish morphology and hierarchy*, Part 1, 1–789. Ishizaki-Shoten, Tokyo. [In Japanese.]
- Mecklenburg, C.W., Mecklenburg, T.A. & Thorsteinson, L.K. (2002) *Fishes of Alaska*. American Fisheries Society, Bethesda, Maryland, 1037 p.
- Nakabo, T., editor (2000) *Fishes of Japan with pictorial keys to the species*, second edition. Tokai University Press, i–lvi, 1–866 p. [In Japanese.]
- Nakabo, T., editor (2002) *Fishes of Japan with pictorial keys to the species*, English edition. Tokai University Press, i–lxi, 1–866.
- Okada, Y. & Matsubara, K. (1938) *Keys to the fishes and fish-like animals of Japan, including Kuril Islands, southern Sakhalin, Bonin Islands, Ryukyu Islands, Korea and Formosa*. Keys to Fishes Japan, i–xl, 1–584. [In Japanese.]
- Orr, J.W. & Busby, M.S. (2001) *Prognatholiparis ptychomandibularis*, a new genus and species of the fish family Liparidae (Teleostei: Scorpaeniformes) from the Aleutian Islands, Alaska. *Proceedings of the Biological Society of Washington*, 114(1), 51–57.
- Orr, J.W. (2004) *Lopholiparis flerxi*, a new genus and species of snailfish (Scorpaeniformes: Liparidae) from the Aleutian Islands, Alaska. *Copeia*, 2004(3), 551–555.
- Pietsch, T.W. & Grobecker, D.B. (1987) *Frogfishes of the World. Systematics, zoogeography, and behavioral ecology*. Stanford University Press, Stanford, California, 420 p.
- Pitruk, D.L. (1990) A preliminary list and distribution of species of fishes of the family Liparididae in the Okhotsk Sea. *Trudy Zoologicheskogo Instituta Akademia Nauk SSSR* 213, 35–45. [In Russian, English summary.]
- Pitruk, D.L. & Fedorov, V.V. (1993) *Allocareproctus* gen. novum (Scorpaeniformes, Liparidae) a new genus of snailfishes from the Northwest Pacific Ocean. *Voprosy Ikhtiologii*, 33(1), 16–20. [In Russian. English translation in *Journal of Ichthyology*, 33(5), 99–107.]
- Sheiko, B.A. & Fedorov, V.V. (2000) *Catalog of vertebrates of Kamchatka and adjacent waters, part I*. Petropavlovsk-Kamchatsky, Russia: Kamchatskiy Petchatniy Dvor, p. 7–69. [In Russian.]
- Stein, D.L. (1978) A review of the deepwater Liparidae (Pisces) from the coast of Oregon and adjacent waters. *Occasional Papers of the California Academy of Sciences*, 127, 1–55.
- Stein, D.L., Chernova, N.V. & Andriashev, A.P. (2001) Snailfishes (Pisces: Liparidae) of Australia, including descriptions of thirty new species. *Records of the Australian Museum*, 53, 341–406.
- Tokranov, A.M. (2000) Species composition and spatial distribution of snailfish (Liparidae) in Pacific waters off southeastern Kamchatka and the northern Kuril Islands. *Voprosy Ikhtiologii*, 40(2), 176–186. [In Russian. English translation in *Journal of Ichthyology*, 40(7), 139–149.]
- Vinnikov, A.V. & Novikov, R.N. (2004) Catches of *Allocareproctus jordani* (Liparidae) in the eastern part of the Sea of Okhotsk. *Voprosy Ikhtiologii*, 44(2), 278–280. [In Russian. English translation in *Journal of Ichthyology*, 44(2), 185–187.]
- Wainwright, P.C. & Turingan, R.G. (1997) Evolution of pufferfish inflation behavior. *Evolution*, 51(2), 506–518.